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USAAVNTA PROJECT NO. 66-06

FEASIBILITY TEST OF TRACTOR TAIL ROTOR MODIFICATION ON THE AH-1G HELICOPTER

FINAL REPORT

JOHN R. MELTON
PROJECT ENGINEER

GARY C. HALL
MAJOR, TC
US ARMY
PROJECT PILOT

MARCH 1968

Army Materiel Comd
attn: AMCPM-CH- Wash. D.C. 20315

US ARMY AVIATION TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

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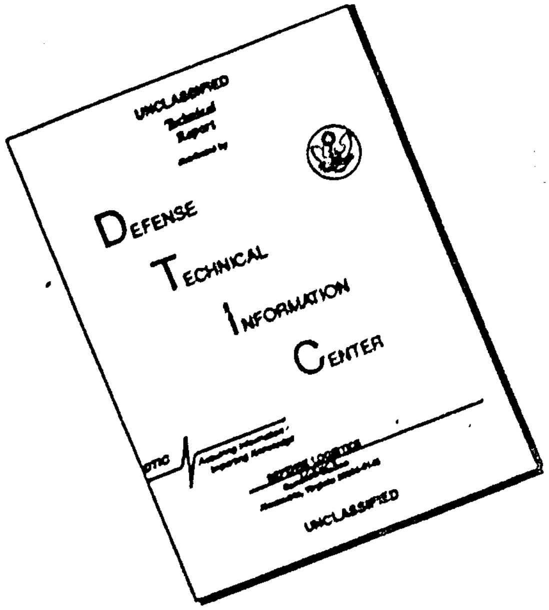

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EDWARDS AIR FORCE BASE, CALIFORNIA 93523

SAVTE P

30 April 1968

SUBJECT: Change No. 1 to Final Report for Feasibility Test of Tractor Tail Rotor Modification on the AH-1G Helicopter, USAAVNTA Project No. 66-06

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The following changes are made to subject final report:

a. Page ii, reverse of front cover, change AMCPM-LH to read AMCPM-IR in lines 5, 6, 22.

b. Document Control Data - R&D, DD Form 1473 following page 72 change:

(1) Item 10, change Hq, US Army Aviation Materiel Command, Attn: AMSAV-O, P. O. Box 209, Main Office, St Louis, Missouri 63166 to read Hq, US Army Materiel Command, Attn: AMCPM-IR, Washington, D. C. 20315.

(2) Item 12, change Commanding General, US Army Aviation Materiel Command ATTN: AMSAV-O, P. O. Box 209, Main Office, St. Louis, Missouri 63166 to read Hq, US Army Materiel Command, Attn: AMCPM-IR, Washington, D. C. 20315.

FOR THE COMMANDER:

1 Incl
as

FRANK A. LEAVENS
CPT, AGC
Adjutant

AD______________________________

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ABSTRACT

A feasibility test of the tractor tail rotor modification of the AH-1G helicopter was conducted near Fort Worth, Texas (550-feet elevation), and Alamosa, Colorado (7535-feet elevation), during the period 7 October to 19 October 1967. This test was conducted to obtain quantitative flight test data to serve as a basis for determining if the tractor tail rotor modification proposed by the contractor for the AH-1G helicopter would correct the directional control problems which currently exist on the AH-1G helicopter with the standard tail rotor configuration. This test revealed that in-ground-effect (IGE) low speed directional control and IGE low speed dynamic directional stability were greatly improved by installation of the tractor tail rotor. IGE directional control limitations with the standard tail rotor installed were encountered at approximately 8100 pounds gross weight near sea level in previous tests. This test with the tractor tail rotor did not reveal any IGE directional control limitations at approximately 8940 pounds gross weight and near sea level. The test results indicate that additional directional control could be obtained with the tractor tail rotor, if the geometry of the directional control system were changed to negate the adverse effects of the stability and control augmentation system (SCAS) on the ability to obtain full left tail rotor pitch. The highest tail rotor horsepower encountered with large left pedal inputs to arrest hovering turns was 250 shaft horsepower. These tests proved that directional control deteriorated with increased gross weight, increased density altitude or decreased rotor speed. The test aircraft exhibited SCAS coupled pylon motion which has been a continuing problem on the AH-1G helicopter.

FOREWORD

During the conduct of the feasibility test of the tractor tail rotor both at Fort Worth, Texas, and Alamosa, Colorado, the helicopter and special test instrumentation were maintained under contract by Bell Helicopter Company personnel. At Fort Worth, Texas, the City of Grand Prairie, Texas, provided the test site at Grand Prairie Municipal Airport. At Alamosa, Colorado, the city of Alamosa provided the test site at Alamosa Municipal Airport. The Alamosa Volunteer Fire Department provided fire fighting equipment and personnel.

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INTRODUCTION

BACKGROUND

1. During tests conducted by the US Army Aviation Test Activity (USAAVNTA) on AH-1G helicopter S/N 66-15246 in April 1967 (ref 2, app I), it was determined that the directional control power was inadequate at some conditions within the contractor's proposed flight envelope. That test was conducted with a 20-degree tail rotor rigging. The contractor rerigged the tail rotor to 23 degrees, as a result of these findings, in an attempt to solve the directional control power problem. During tests in the 23-degree rigging configuration, the contractor encountered high power loads in the tail rotor drive train when full left directional control inputs were required. The high power loads (290 horsepower) caused considerable damage to the 42-degree and 90-degree gear boxes. The output gear train from the main transmission to the tail rotor drive was also damaged. Replacement of these components was required. Later, in an attempt to solve the problem by use of a reconfigured tail rotor blade, the same phenomenon was experienced with 270-peak horsepower to the tail rotor. This necessitated replacement of the three gear boxes again. The maximum continuous operation design point for the tail rotor is 120 horsepower. At this point the contractor determined that the maximum allowable left pedal tail rotor rigging was 19 degrees due to the tail rotor drive train power loading problem. The contractor stated that approximately 230 horsepower was the maximum attainable with a 19-degree tail rotor rigging. While pursuing a permanent solution to this problem on another test helicopter, the contractor was directed to determine the in-ground-effect (IGE) flight envelope at the 19-degree tail rotor rigging with AH-1G helicopter S/N 66-15248 for gross weights of 7500, 8500, and 9500 pounds (ref 3, app I). At the completion of this contractor test, USAAVNTA was directed by, US Army Aviation Materiel Command (USAAVCOM) to determine the areas of inadequate directional control power for 8100 pounds gross weight with a center of gravity of 194.5 inches. That test proved that there were areas of inadequate directional control at 8100 pounds, the lowest practical mission weight (ref 4 and 5, app I). As a result of these tests, various warnings and flight restrictions were imposed on the AH-1G helicopter. Since these restrictions were undesirable and the high horsepowers being experienced by the tail rotor drive train were not desirable, the contractor continued to pursue a solution. The contractor proposed that a tractor type tail rotor, described in reference 6, appendix I, be installed on the AH-1G helicopter to alleviate the problem. Limited flight tests by the contractor were conducted near sea

level and at a high altitude test site. These tests proved to the contractor's satisfaction that the tractor tail rotor configuration was the optimum long range solution to the problem and led to the submission of Engineering Change Proposal AH-1G 350, Tractor Tail Rotor (ref 6, app I). On 25 September 1967, USAAVCOM directed that USAAVNTA conduct an evaluation of the tractor tail rotor (ref 7, app I). The test sites selected for these tests were Fort Worth, Texas (550-feet elevation) and Alamosa, Colorado (7535-feet elevation).

TEST OBJECTIVES

2. To provide quantitative flight test data to serve as a basis for determining if the tractor tail rotor modification proposed by the contractor for the AH-1G helicopter will correct the directional control problem defined in reference 2 through 5, appendix I.

3. To provide quantitative flight test data to serve as a basis for determining if Bell Helicopter Company Engineering Change Proposal AH-1G 350 should be approved.

DESCRIPTION

4. The test aircraft is the second prototype AH-1G tactical helicopter produced by Bell Helicopter Company designed specifically for the armed role. It is a tandem, two-place, high speed conventional helicopter with a two-bladed door hinge type main rotor and prototype antitorque rotor. The prototype tail rotor is located on the right side of the tail boom instead of the standard left side location. The prototype is similar to that proposed in reference 6, appendix I. The tail rotor blades are standard and set at the standard 19-degree rigging for full left pedal. A three-axis stability and control augmentation system (SCAS) is used in lieu of the stabilizer bar to improve helicopter stability and handling qualities. The test helicopter is powered by a Lycoming T53L-13 turboshaft engine rated at 1400 shaft horsepower (shp) at sea level (S.L.) standard day conditions. The power plant is derated to 1100 shp at 314 rotor rpm due to maximum torque limits of the helicopter main transmission. The distinctive features of the test helicopter are the 36-inch wide fuselage, the stub mid-wings with four external stores stations, and the integral chin turret. The armament configuration of the AH-1G is changed by varying wing stores. The flight control system is a positive mechanical type with conventional helicopter controls in the pilot's aft cockpit. The copilot/gunner's forward cockpit is provided with sidearm collective and cyclic controls. Control forces are reduced by hydraulic servo cylinders connected to the control

system mechanical linkage and powered by dual transmission driven pumps. A synchronized elevator is used to increase static longitudinal stability and lengthen the center of gravity (C.G.) range. A force trim system is provided in the control system to give artificial control feel and positive control centering. Ausform Armor protection is provided for the crew, engine fuel control, and engine compressor section.

SCOPE OF TEST

5. The scope of this test conducted on AH-1G helicopter S/N 66-15246 at Grand Prairie Municipal Airport near Fort Worth, Texas, and Alamosa Municipal Airport, Colorado, was limited entirely to directional control testing during IGE flight. The reason for this limited scope of test was that the tractor tail rotor is a prototype system and has not been tested by the contractor throughout the flight envelope.

6. The flight restrictions which governed this test are presented in appendix IV. A safety of flight release for these flight restrictions was issued by USAAVCOM (ref 8, app I).

7. Eighteen flights were conducted during this test for a total of 12.4 test hours during an elapsed calendar time of 12 days.

8. Three types of tests were conducted: paced flight, hovering in winds, and arrestment of turn rates. The test conditions for these tests are listed in Table 1.

Table 1. Test Conditions.

TYPE OF TEST	AVG GROSS WEIGHT (lb)	AVG DENSITY ALTITUDE (ft)	ROTOR SPEED (rpm)	CENTER OF GRAVITY (in.)
Paced Flight	8030	7330	324	192.5
Paced Flight	8020	7790	324	192.5
Paced Flight	8680	7190	324	192.4
Paced Flight	8940	-150	324	193.5
Paced Flight	9510	-120	324	193.7
Hovering in wind	9130	8760	324	192.5
Arrestment of Turn Rates	9100	8750	324	192.5
Arrestment of Turn Rates	8100	7920	324	192.7

METHODS OF TEST

9. The methods for the three tests conducted are described briefly below:

a. Paced Flight: Paced IGE flight at various relative wind azimuths was conducted in light-steady winds (0 to 6 knots (kt)) using a calibrated pace car and wind speed and direction measuring devices in immediate proximity to the test site. Wind speed and direction were continuously and accurately recorded during all testing and correlated with each data point. A Very High Frequency (VHF) radio was installed in the test helicopter which netted with other VHF radios in the pace car and at the wind measuring site. This was necessary to correlate data points. Control positions, rates, attitudes, and tail rotor power were recorded on oscillograph at stabilized IGE flight speed increments up to the limit of control authority or 30 kt, whichever occurred first.

b. Hovering in winds: Stabilized hovering over a spot was conducted at various wind azimuths and velocities. Control position requirements and tail rotor power were recorded as function of wind azimuth.

c. Arrestment of Turn Rates: While hovering over a spot, right turn rates of various magnitudes were arrested at a selected helicopter heading with varying rates of pedal application. Pedal requirements and tail rotor power were recorded.

CHRONOLOGY

10. The chronology of this test program is as follows:

Test helicopter received	7 October 1967
Flight test commenced	7 October 1967
Flight test completed	19 October 1967
Test helicopter returned to contractor	19 October 1967
Draft test report submitted	31 October 1967
Final test report forwarded	March 1968

RESULTS AND DISCUSSION

PACED FLIGHT

11. Paced flight at selected relative wind azimuths was the primary technique used to produce the quantitative definition of the conditions of inadequate directional control. Figures 1 through 47, appendix II, present the results of these tests. The mean (average) directional control position for the condition and the maximum excursion toward full left directional control input for each data point were determined. The magnitude of the maximum excursion from the average is some indication of the degree of instability for the condition. Figures 1, 13, 24, 34, and 43, appendix II, summarize the conditions for inadequate directional control.

12. For the purposes of this test, directional control was determined to be inadequate where the maximum excursion of directional control extended to less than 12.5 percent of full travel. Depending upon the position of the SCAS actuator at any instant, the left directional control "stop" may vary from 0 percent to 12.5 percent of full SCAS off left tail rotor pitch. This can result in something less than the 19-degree full left tail rotor pitch setting when the pedal is on the "stop". With the directional control channel of the SCAS disengaged, full left tail rotor pitch is always available.

13. Figures 2 through 12, appendix II, present the results of the tests conducted at 8030 pounds average gross weight, 324 rotor rpm, and 7330 feet density altitude. Figure 1, appendix II, summarizes the conditions for inadequate directional control (shaded areas). This figure shows that directional control is inadequate for the conditions tested for air speeds greater than 14 kt true air speed at relative wind azimuths in right sideward flight of approximately 55 degrees to 125 degrees. These test conditions were the baseline conditions for the tests conducted at the high altitude test site. From this baseline, gross weight and rotor speed were varied to determine their affects on the areas of inadequate directional control.

14. Figures 14 through 23, appendix II, present the results of the tests conducted at 8020 pounds average gross weight, 314 rotor rpm, and 7790 feet density altitude. Figure 13, appendix II, summarizes the conditions for inadequate directional control (shaded areas).

This figure shows that directional control is inadequate in several areas for these test conditions. In right sideward flight directional control became inadequate at 8 kt. The critical speed increased to approximately 15 kt, 20 degrees to 30 degrees either side of straight right sideward flight. Two other small areas of inadequate directional control were detected in straight rearward flight and at the 230 degree to 270 degree relative wind azimuths from approximately 7-14 kt. Since all other parameters were the same as baseline (para 13) except rotor speed which was reduced to 314 rpm, it is concluded that reduced rotor speed had a significant adverse affect on directional control.

15. Figures 25 through 33, appendix II, present the results of the tests conducted at 8680 pounds average gross weight, 324 rotor rpm, and 7190 feet density altitude. Figure 24, appendix II, summarizes the conditions for inadequate directional control (shaded areas). This figure shows that directional control is inadequate in several areas for these test conditions. In right sideward flight the critical speed for inadequate directional control varied from approximately 14 kt in straight right sideward flight to approximately 8 kt at 110 degree relative wind azimuth. At relative wind azimuths from 150 to 180 degrees, a small area of inadequate directional control was noted from 6 kt to 12 kt. Since gross weight was the only parameter changed from the baseline conditions, it is apparent (comparing figure 24 with figure 2, appendix II) that an increase in gross weight adversely affects directional control.

16. Figures 35 through 42, appendix II, present the results of the tests conducted at 9510 pounds average gross weight, 324 rotor rpm, and -120 feet density altitude. Figure 34, appendix II, summarizes the conditions for inadequate directional control (shaded areas). This figure shows that a small area of inadequate directional control exists in the right sideward flight between relative wind azimuths of approximately 65 degrees and 105 degrees and true airspeeds between 15 kt and 28 kt. The effects of density altitude on directional control are indicated by this test since only a small area of inadequate control existed at near sea level conditions at 9510 pounds gross weight whereas at 9130 pounds gross weight at the high altitude test site directional control was inadequate at practically all relative wind azimuths in winds from 0 kt to 8 kt as shown in figure 48, appendix II.

17. Figures 44 through 47 present the results of the tests conducted at 8940 pounds average gross weight, 324 rotor rpm, and -150 feet density altitude. Figure 43, appendix II, summarizes the conditions for inadequate directional control (shaded areas). No areas of inadequate directional control were detected for the conditions tested at any relative wind azimuth up to true airspeeds in excess of 30 kt.

18. The paced flight tests showed that reduced rotor speed, increased gross weight, and increased density altitude all adversely affect directional control. It is most significant that at 8010 pounds average gross weight at near sea level with the standard tail rotor, an area of inadequate directional control existed between relative wind azimuths of approximately 170 degrees and 250 degrees and true airspeed of 8 kt to 13.5 kt (para 22, ref 4, app I). At the same test site, with the tractor tail rotor, no areas of inadequate directional control exist at a gross weight of 8940 pounds. At near sea level density altitude 324 rpm, the gross weight for adequate directional control was raised from less than 8010 pounds to more than 8940 pounds with the installation of the tractor tail rotor. A comparison of the tractor tail rotor to the standard tail rotor at high density altitude was not possible due to insufficient standard tail rotor data. Density altitude, however, should have a similar adverse affect upon both the standard and tractor tail rotor. The improvement in directional control with the tractor tail rotor measured near sea level should exist at higher density altitudes.

19. A secondary effect contributing to the improvement of directional control with the tractor tail rotor was reduction of the magnitude and frequency of random external directional disturbances. With combinations of wind azimuth and velocity approaching areas of inadequate control, the standard tail rotor required rapid and sometimes large directional control excursions to maintain heading (ref 4, app I). With the tractor tail rotor, the directional disturbances were greatly reduced, and large excursions of directional control were not required.

20. Table 2 through 6, appendix II, present the peak tail rotor shaft horsepower obtained for each data point. These values are included on the figures of tail rotor pitch versus true airspeed.

HOVERING IN WINDS

21. Figure 48, appendix II, shows the tail rotor pitch required to hover at 9130 pounds gross weight, 192.5 inch C.G., 324 rpm rotor speed, and 8760 feet density altitude. During this test the wind was variable in direction and velocity so that the accuracy of the wind azimuth data was compromised. However, as figure 48, appendix II, indicates, directional control was inadequate for most wind azimuths, including low wind velocities (less than 8 kt).

22. The test conditions of figure 48, appendix II, are well within the hover performance envelope of the aircraft. This condition results in the hover ceiling of the helicopter being defined by

available directional control rather than engine power available. This also means that the hover ceiling of the helicopter will vary greatly with both wind velocity and azimuth.

ARRESTMENT OF TURN RATES

23. Figure 49, appendix II, shows the tail rotor shaft horsepower resulting from arresting right hovering turns. Peak horsepowers of approximately 250 shaft horsepower were recorded. These high horsepowers resulted in changes in the wear patterns on the tail rotor drive train gear boxes, but replacement was not required. Peak tail rotor shaft horsepower was found to be primarily a function of the total pedal displacement required to arrest the turn rate. Based upon the very limited amount of data available for analysis, the tail rotor power required to arrest a turn rate could not individually be defined in terms of yaw rate, yaw angular acceleration, or rate of pedal displacement. All these parameters undoubtedly affect the magnitude of the resulting tail rotor shaft horsepower, but their individual contributions could not be defined with the data available from these tests. However, there is sufficient information to show that the most significant parameter affecting peak tail rotor shaft horsepower is the size of the pedal displacement required to arrest the turn rate and not the rate of displacement. This indicates that the installation of a rate limiting device on the directional controls or the publishing of yaw rate limitations in the operator's manual is not appropriate. A note to avoid large pedal inputs which are not required in normal operation of the helicopter should be included in the pilot's handbook.

SCAS PYLON COUPLING

24. During this test program, while flying from the contractor's facility to the test site, SCAS coupled pylon motion was encountered. The severity of the oscillation was comparable to that reported in reference 4, appendix I. The test aircraft was equipped with the pylon position sensors designed to eliminate this continuing problem. Production AH-1G aircraft are presently delivered with essentially the same pylon position sensing equipment as that installed on the test aircraft.

CONCLUSIONS

25. Installation of the tractor tail rotor in the AH-1G helicopter results in greatly improved IGE, low speed directional control compared to the standard tail rotor (para 18).

26. The AH-1G helicopter with the tractor tail rotor installed has adequate directional control to hover in a 30-kt wind from any relative wind azimuth at a gross weight of 8940 pounds, density altitude of approximately sea level, and rotor speed of 324 rpm (para 17).

27. At a gross weight of 9510 pounds, density altitude of approximately sea level, and rotor speed of 324 rpm, inadequate directional control exists in the area of a right cross wind between relative wind azimuths of approximately 65 degrees and 105 degrees and wind velocities between 15 and 28 kt (para 16).

28. Directional control deteriorates with increased gross weight, increased density altitude, or decreased rotor speed (para 18).

29. The hover ceiling of the AH-1G is limited for some conditions by inadequate directional control rather than performance (para 22).

30. With the present directional control system geometry, it is possible to have the directional pedal fully to the left stop and not achieve maximum left tail rotor pitch. This results in a decrease in directional control available to the pilot at some conditions of SCAS actuator extension (para 12).

31. The magnitude and frequency of the random external directional distrubances observed with the standard tail rotor at combinations of wind velocity and relative wind azimuth approaching the limits of directional control are greatly reduced with the tractor tail rotor (para 19).

32. With large left pedal inputs to arrest a turn rate, peak tail rotor shaft horsepowers of approximately 250 shaft horsepower were recorded (para 23).

33. The test aircraft exhibited SCAS coupled pylon motion (para 24).

RECOMMENDATIONS

34. Further testing throughout the entire flight envelope should be conducted on the AH-1G helicopter in the tractor tail rotor configuration to insure that no penalties on performance, handling qualities, or structural integrity are suffered as a result of this modification. Particular attention should be focused on high speed maneuvering flight and those flight regimes which demand maximum right directional control requirements (para 5).

35. Consideration should be given to further improving the IGE low speed directional control power characteristics by a redesign of the directional control system geometry to allow the pilot to obtain full left tail rotor pitch with any SCAS actuator position (para 12).

36. If the tractor tail rotor is approved for production in the configuration tested, a note should be included in the pilot's handbook to disengage the directional SCAS channel if inadequate IGE directional control is encountered. This will allow the pilot to obtain full left tail rotor pitch with any SCAS actuator position (para 12).

37. Rotor speed should be maintained at 324 rpm during IGE flight (para 18).

38. Tests should be conducted to determine a final, adequate corrective measure to prevent SCAS coupled pylon motion (para 24).

APPENDIX I REFERENCES

1. Preliminary Draft Letter Plan of Test for, "Feasibility Test of Tractor Tail Rotor Modification on the AH-1G Helicopter," 2 October 1967.

2. Preliminary Letter Report of Phase B, "Engineering Flight Test of AH-1G Helicopter/Hueycobra, S/N 66-15246," April 1967.

3. "Model 209 Controllability, Warning, Approach and Maneuver Envelope Documents," presented by Bell Helicopter Company on 28 July 1967.

4. Preliminary Draft Letter Report, "Engineering Flight Test of the AH-1G Helicopter to Determine the Area of Inadequate Directional Control Power at 8100 Pounds Gross Weight," 17 August 1967.

5. Letter from Cobra Test Team to Commanding Officer, USAAVNTA, subject: "Excessive Gear Box Wear at Standard 19-Degree Tail Rotor Rigging on AH-1G Helicopter," 10 August 1967.

6. Bell Helicopter Company, "Engineering Change Proposal AH-1G350, Improved Anti-Torque System for the AH-1G Helicopter," 29 August 1967.

7. Unclassified Message 9-1388 AMSAV-EF, CG, USAAVCOM to CO, USAAVNTA, Subject: "Evaluation of Tractor Tail Rotor AH-1G," 25 September 1967.

8. Unclassified Message 500-09-11 AMSAV-EF, CG, USAAVCOM to CO, USAAVNTA, subject: "Safety of Flight Release for USAAVNTA Test of Tractor Tail Rotor on AH-1G," 30 September 1967.

APPENDIX II TEST DATA

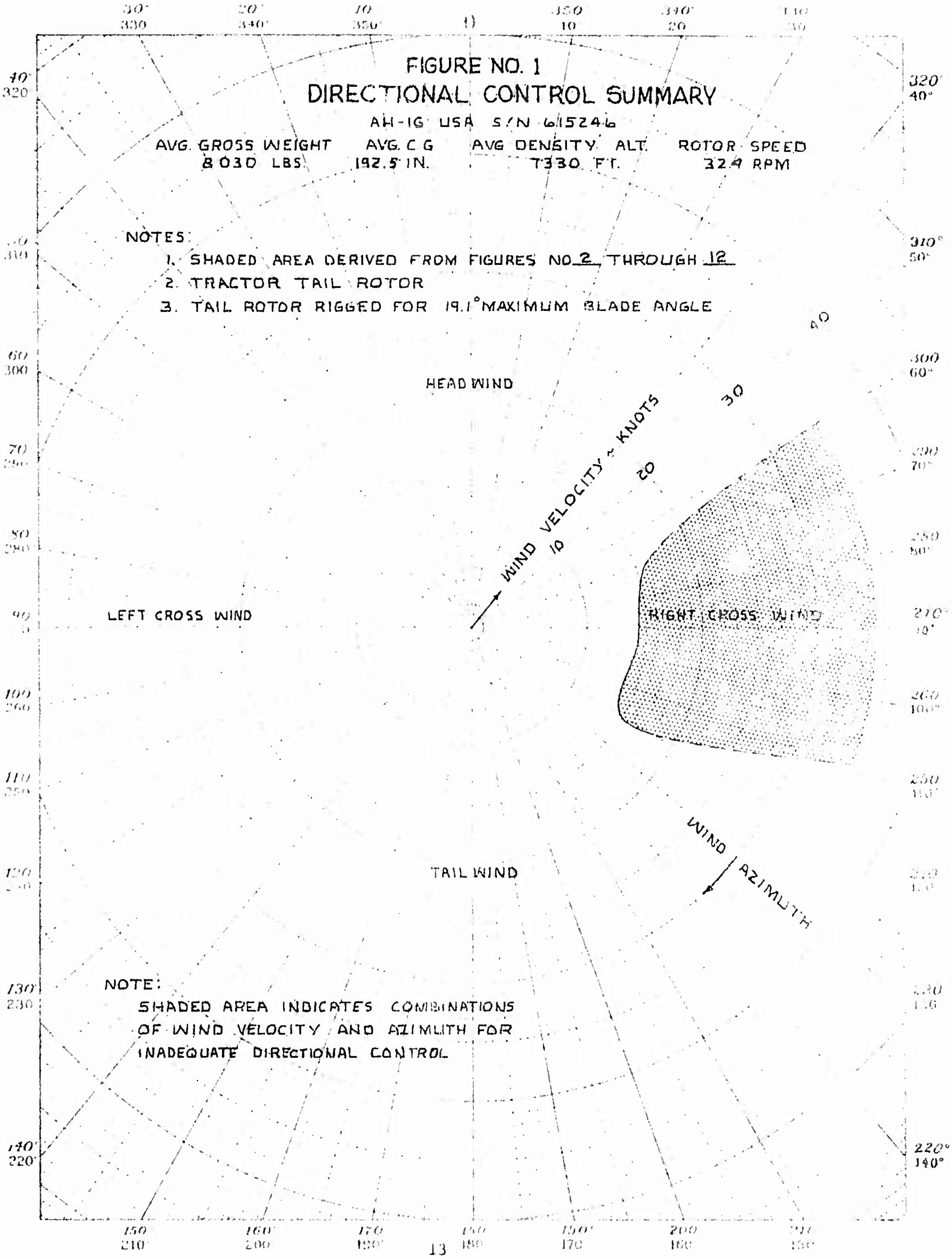
FIGURE NO. 1
DIRECTIONAL CONTROL SUMMARY

AH-1G USA S/N 615246

AVG. GROSS WEIGHT	AVG. C.G.	AVG DENSITY ALT.	ROTOR SPEED
8030 LBS	192.5 IN.	7330 FT.	324 RPM

NOTES:

1. SHADED AREA DERIVED FROM FIGURES NO. 2 THROUGH 12
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE



NOTE:
SHADED AREA INDICATES COMBINATIONS OF WIND VELOCITY AND AZIMUTH FOR INADEQUATE DIRECTIONAL CONTROL

Figure No 2

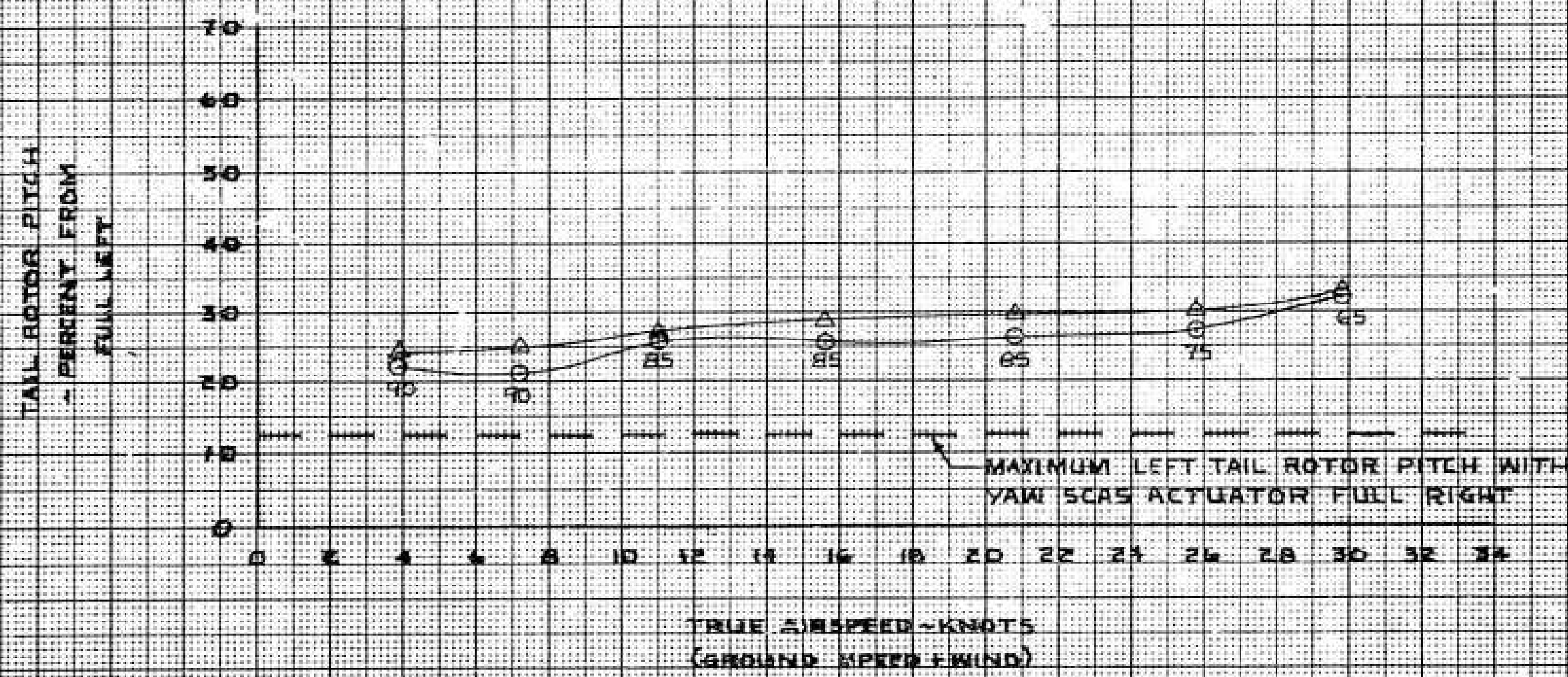
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 20°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8630 LBS	192.6 IN.	7400 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



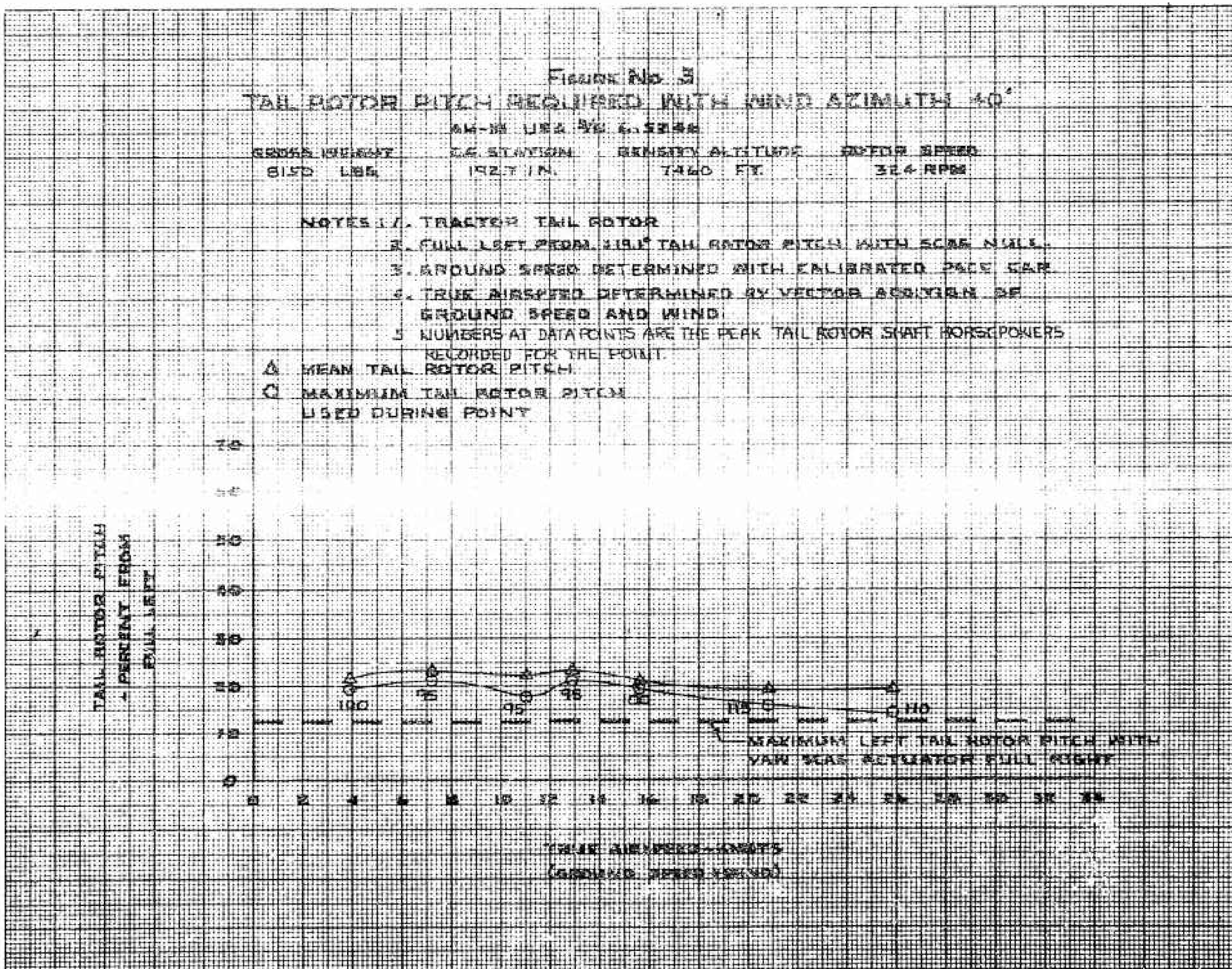


FIGURE No. 3
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 40°
GROSS WEIGHT
8150 LBS.
C.G. STATION
192.7 IN.
DENSITY ALTITUDE
7460 FT.
ROTOR SPEED
324 RPM
NOTES 1. TRACTOR TAIL ROTOR
2. FULL LEFT FROM 11.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
100
95
98
110
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
70
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
TRUE AIRSPEED ~ KNOTS
(GROUND SPEED+WIND)

Figure No 4

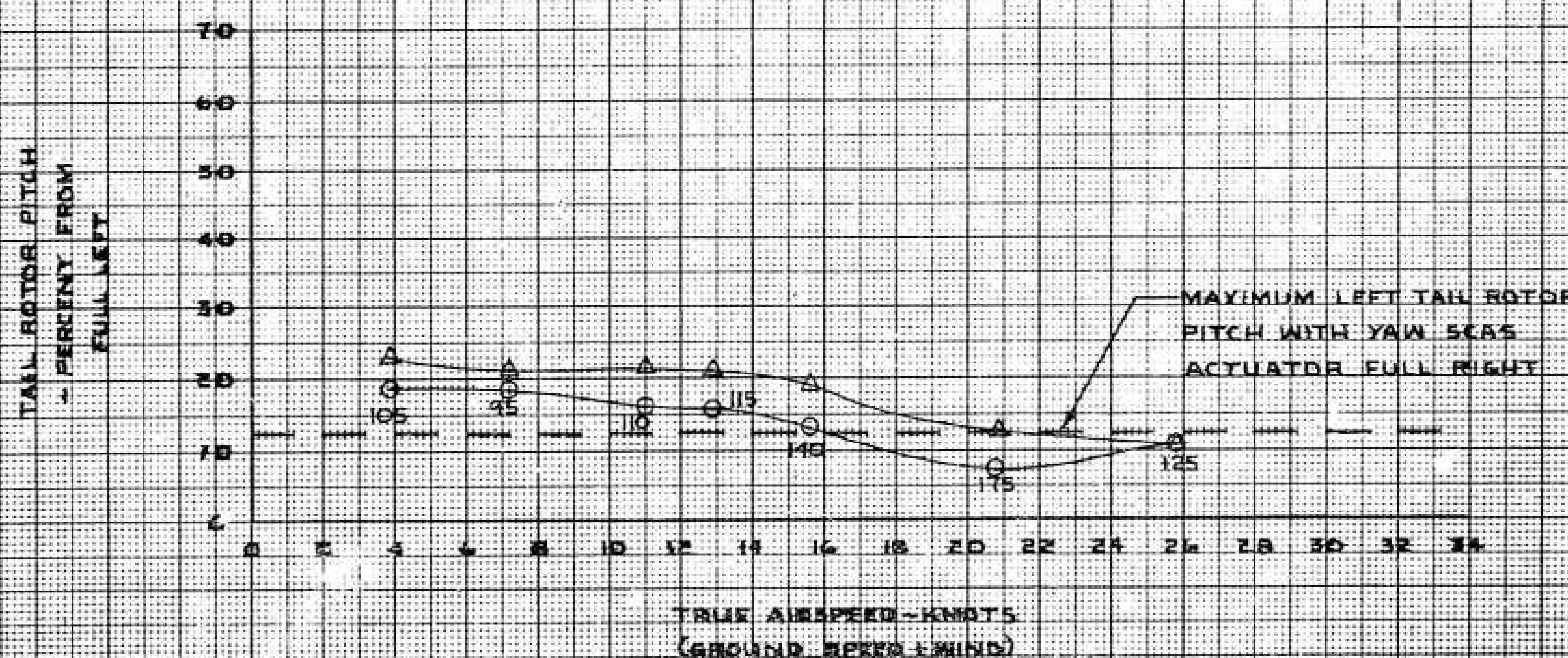
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7920 LBS	192.3 IN.	7360 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



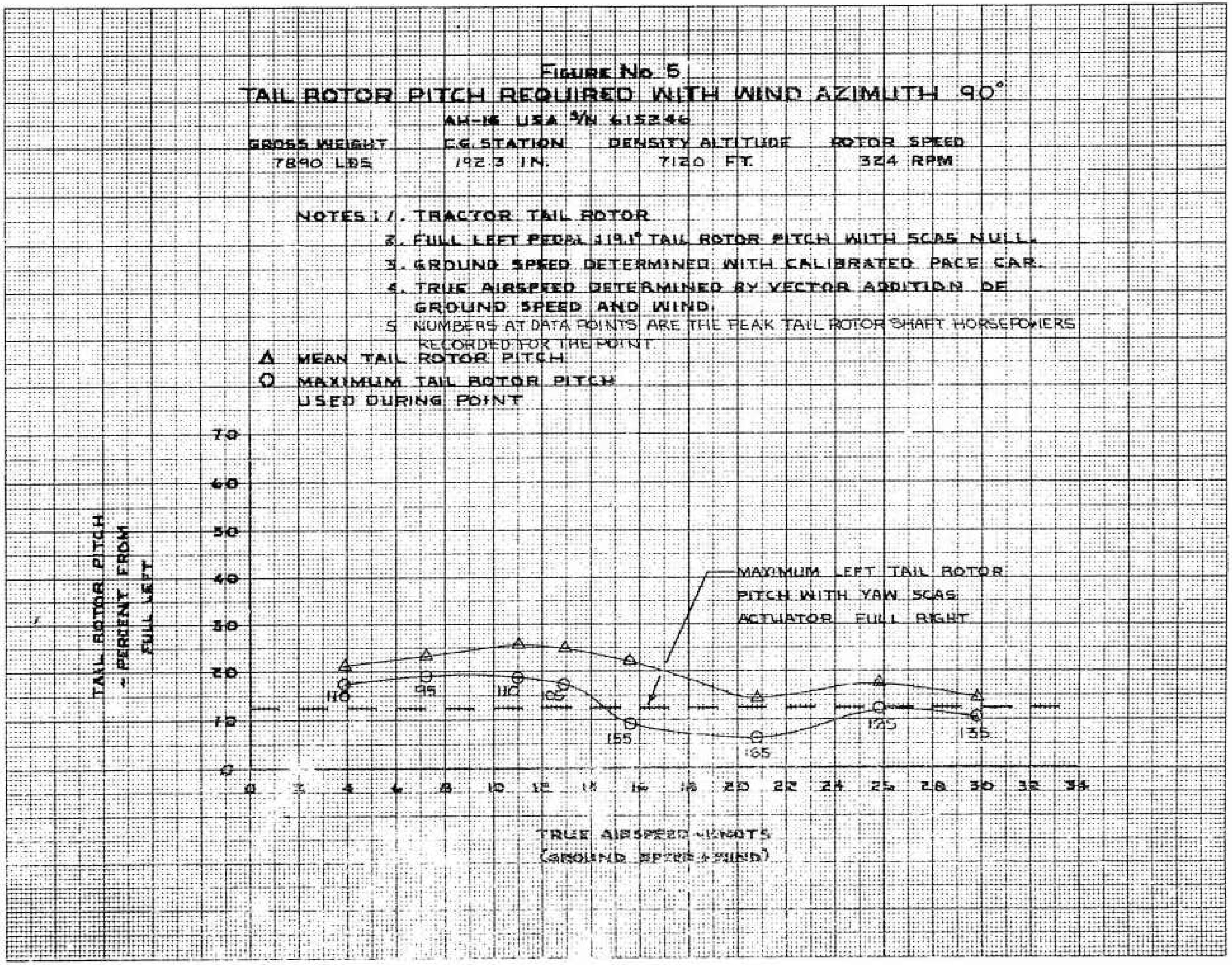


FIGURE No 5
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°
AH-1G USA S/N 615246
GROSS WEIGHT 7890 LBS
C.G. STATION 192.3 IN.
DENSITY ALTITUDE 7120 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
TRUE AIRSPEED ~KNOTS (GROUND SPEED + WIND)

Figure No. 6

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 120°

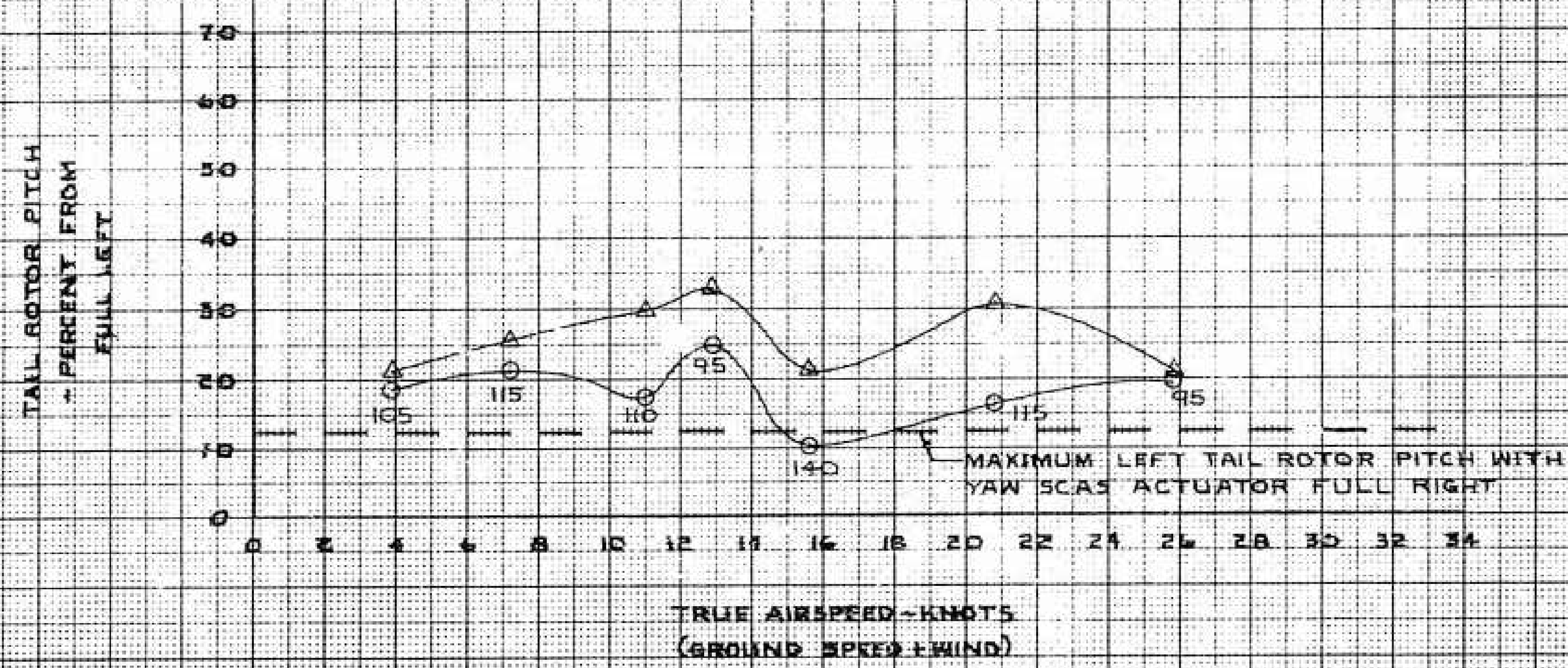
AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7980 LBS	192.5 IN.	7360 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



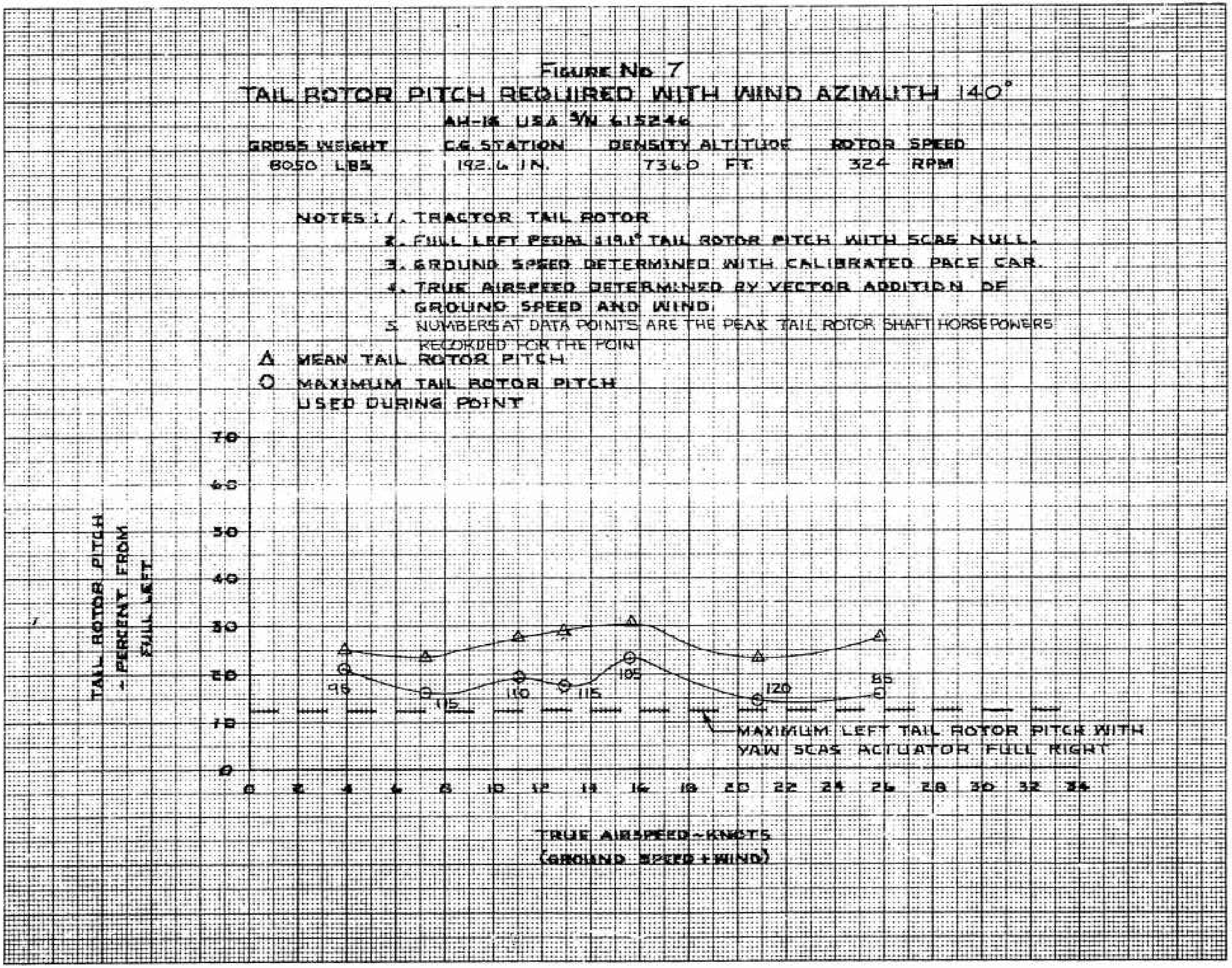


FIGURE No 7
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 140°
AH-1G USA S/N 615246
GROSS WEIGHT 8050 LBS
C.G. STATION 192.6 IN.
DENSITY ALTITUDE 7360 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
70
60
50
40
30
20
10
0
96
115
110
115
105
120
85
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
TRUE AIRSPEED - KNOTS
(GROUND SPEED + WIND)

Figure No. 8

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 160°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8125 LBS	192.7 IN.	7360 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL 319.1° TAIL ROTOR PITCH WITH SCAS NULL.

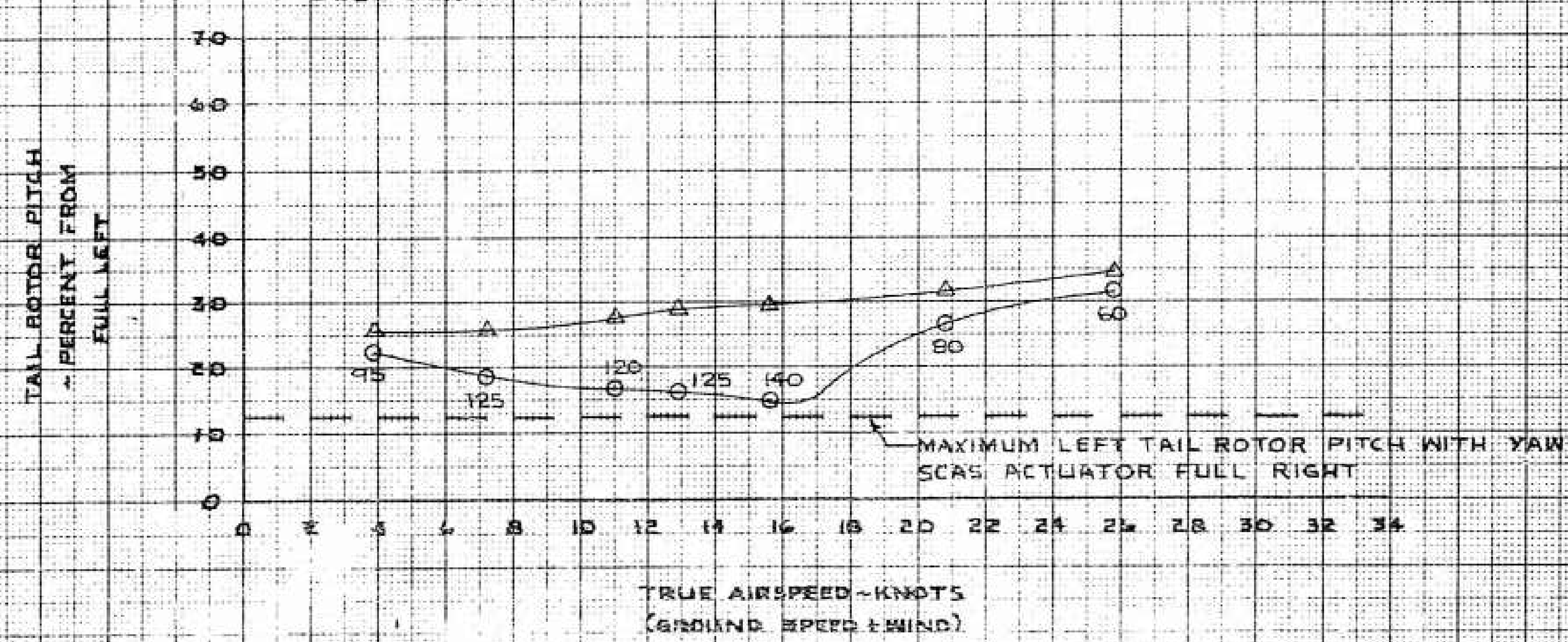
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



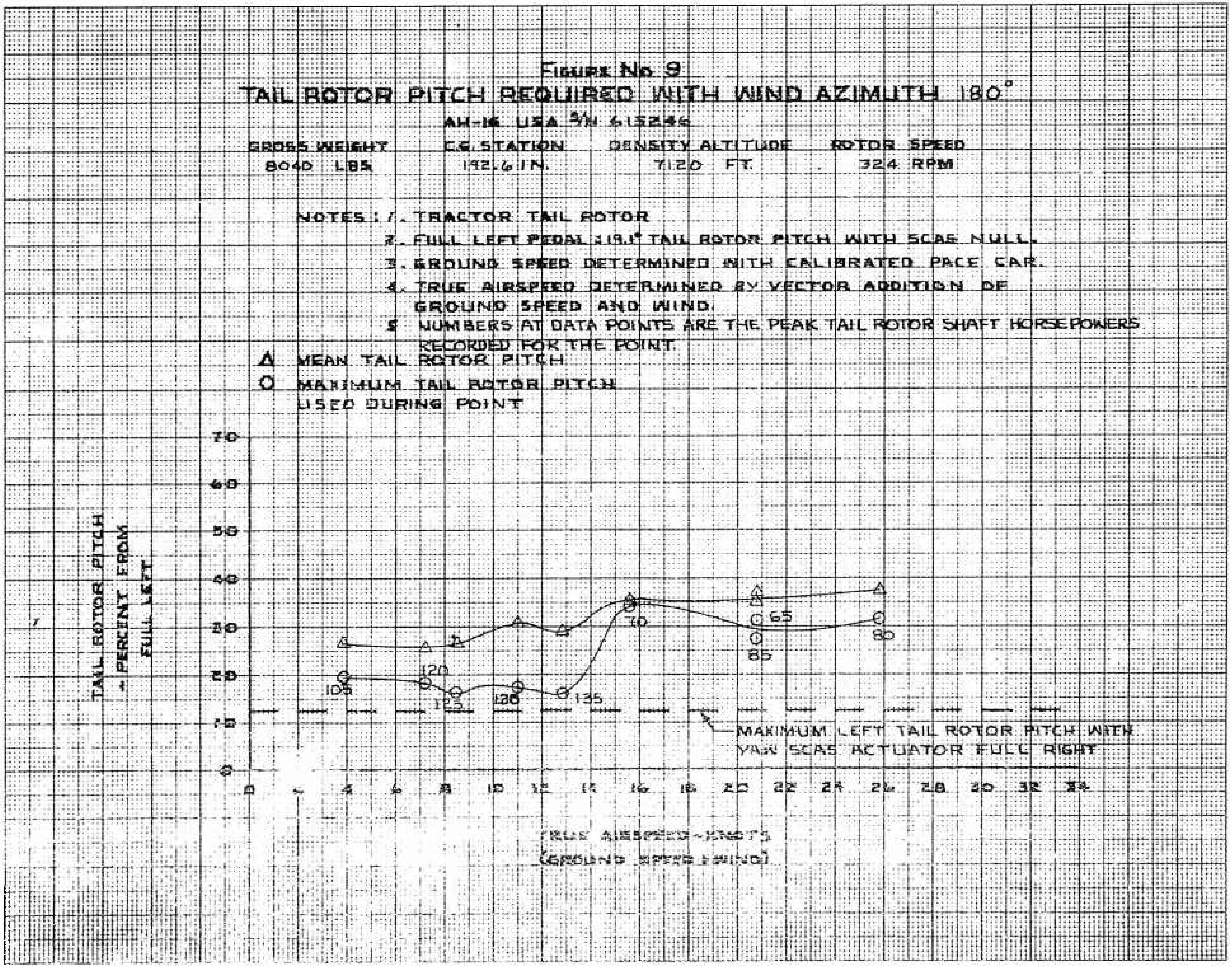


FIGURE No. 9
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°
AH-1G USA S/N 615246
GROSS WEIGHT 8040 LBS
C.G. STATION 192.6 IN.
DENSITY ALTITUDE 7120 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TRUE AIRSPEED ~ KNOTS
(GROUND SPEED + WIND)

FIGURE No. 10

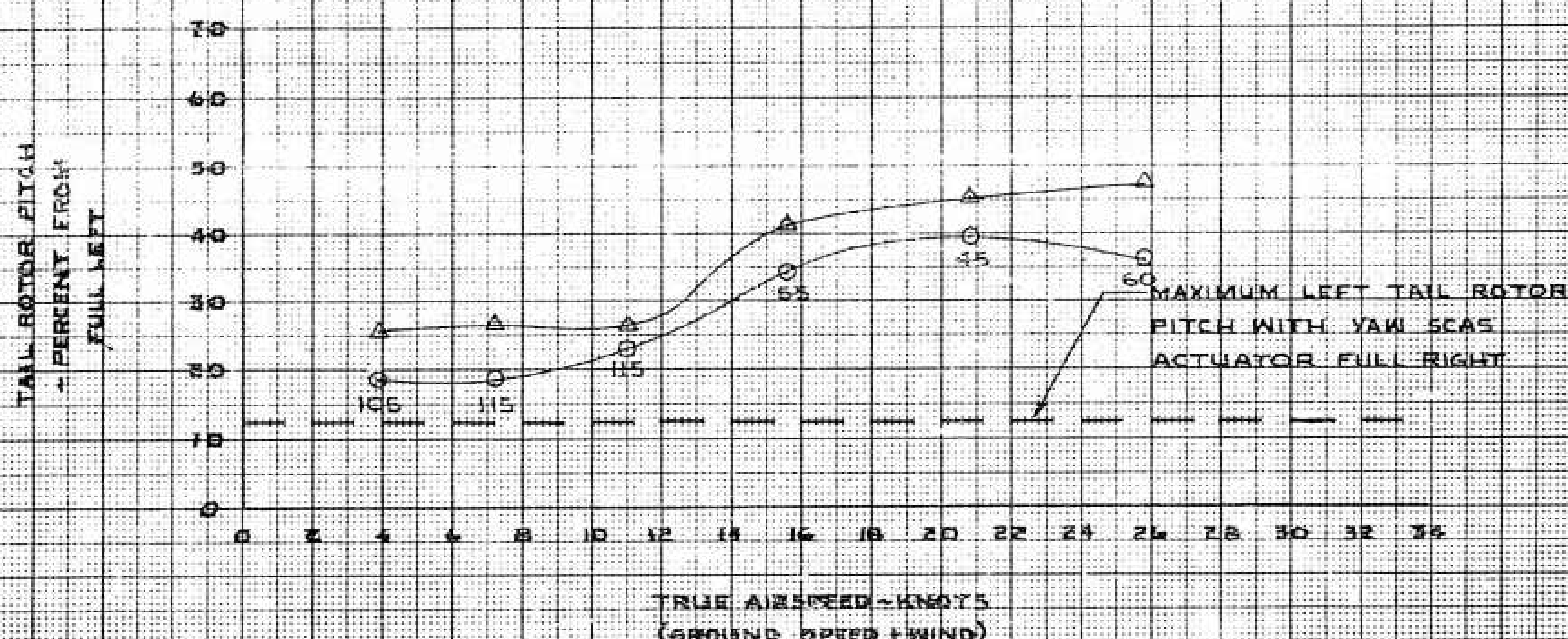
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 200°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7870 LBS.	192.3 IN.	7120 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



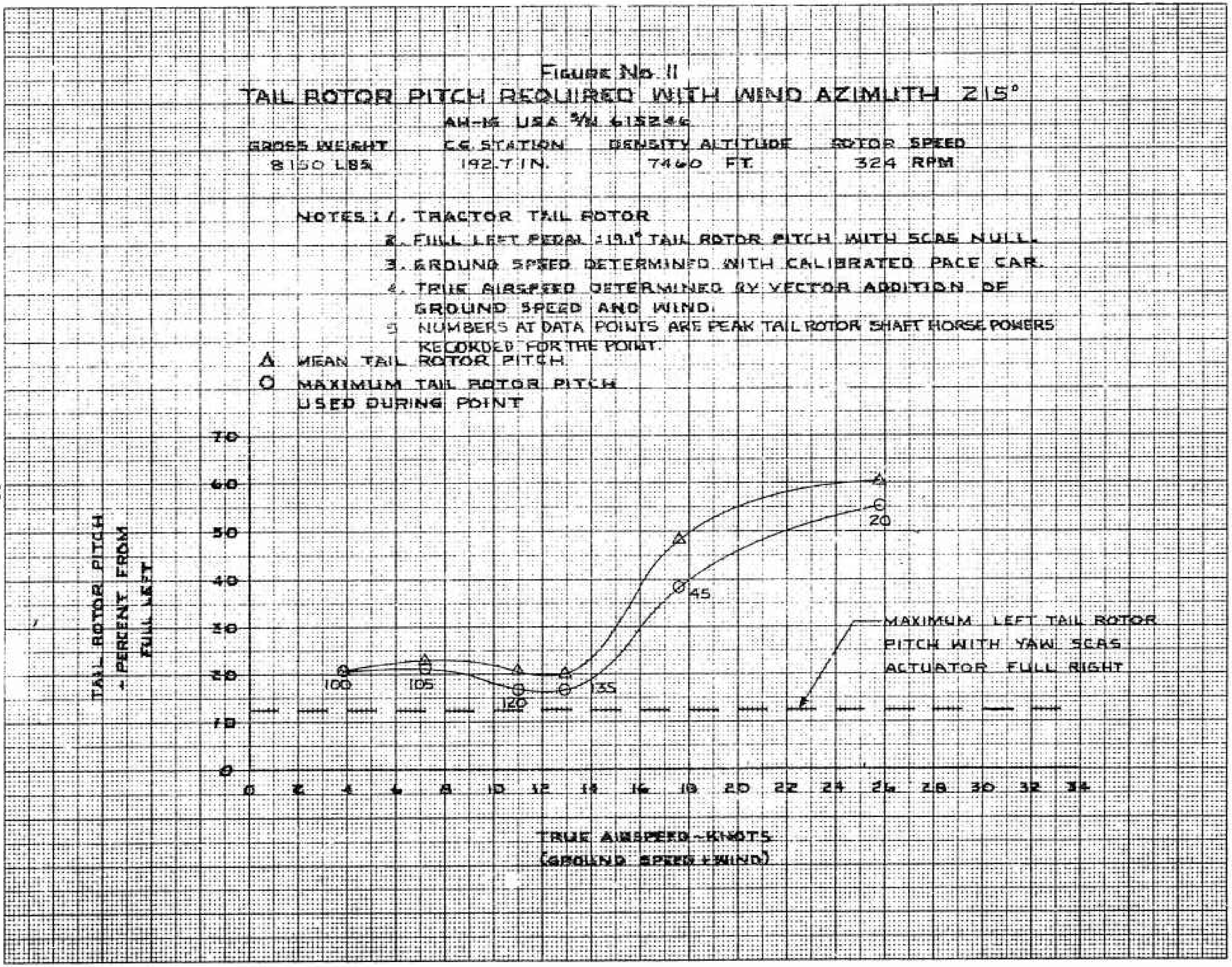


Figure No. 11
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 215°
AH-1G USA S/N 615246
GROSS WEIGHT 8150 LBS
C.G. STATION 192.7 IN.
DENSITY ALTITUDE 7460 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL =19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED FOR THE POINT.
Δ MEAN TAIL ROTOR PITCH
O MAXIMUM TAIL ROTOR PITCH USED DURING POINT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
100
105
120
135
45
20

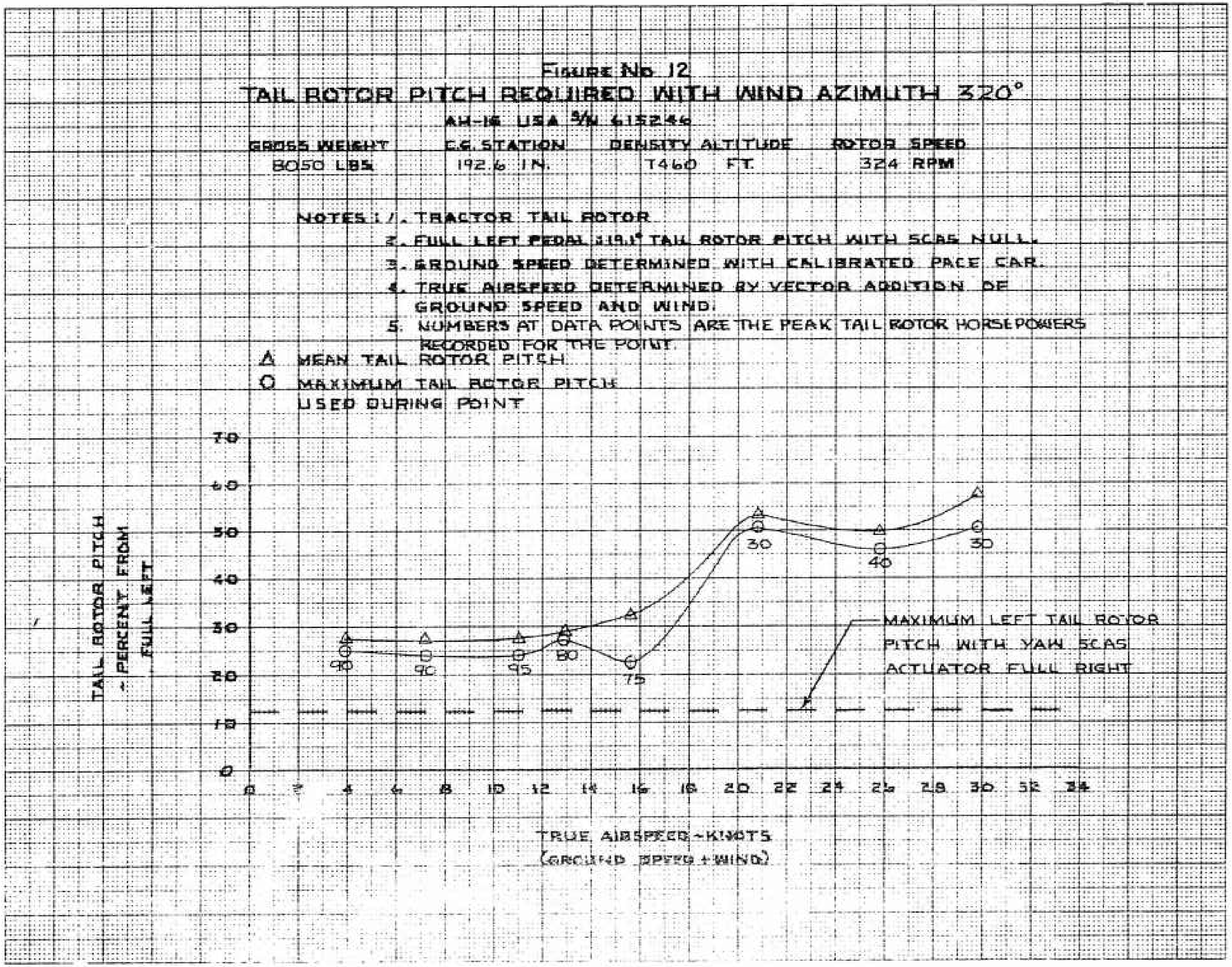


Figure No. 12
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 320°

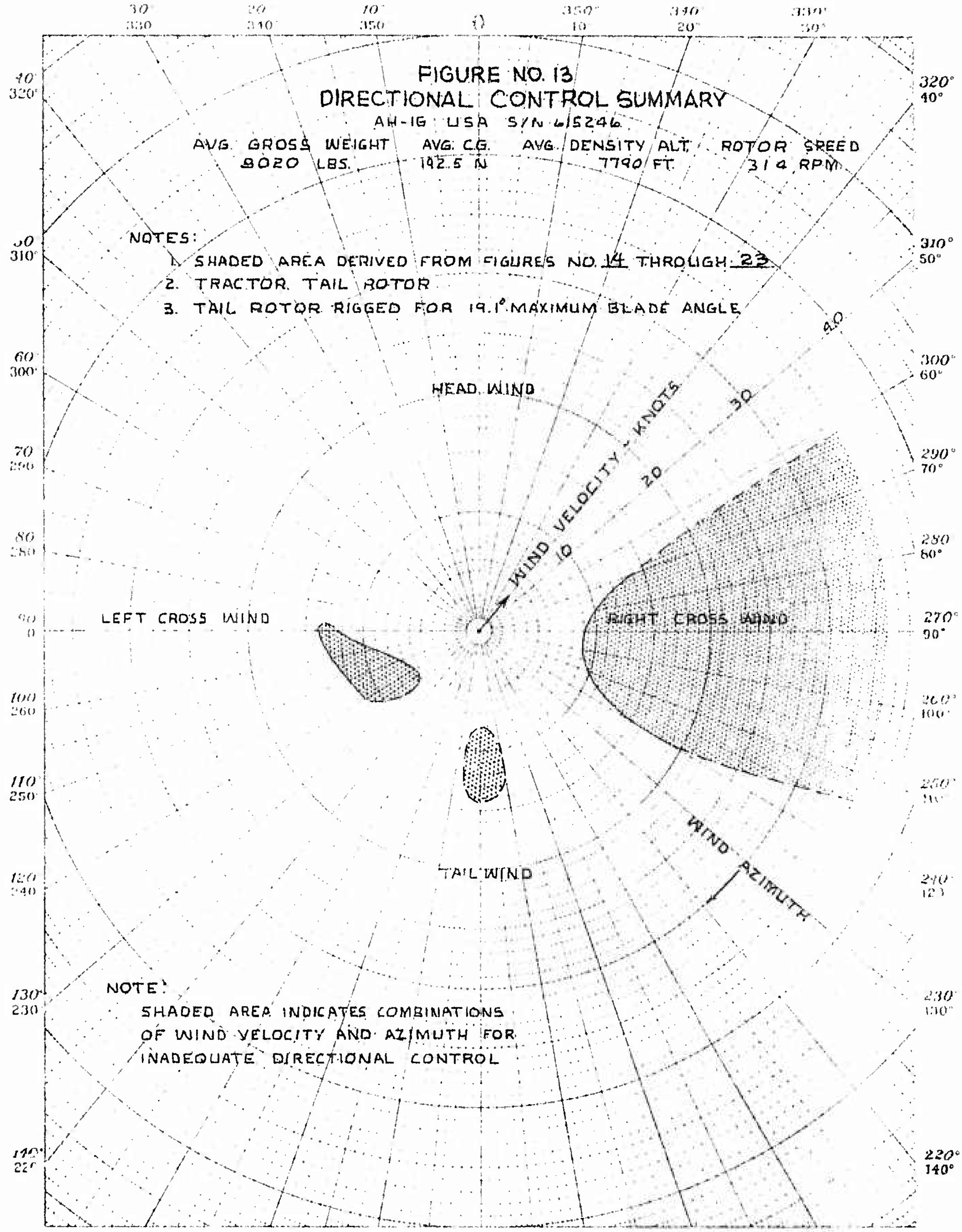


FIGURE NO. 13
DIRECTIONAL CONTROL SUMMARY

FIGURE No. 14

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 30°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7960 LBS	192.3 IN.	7710 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL =19.1° TAIL ROTOR PITCH WITH SCAS NULL.

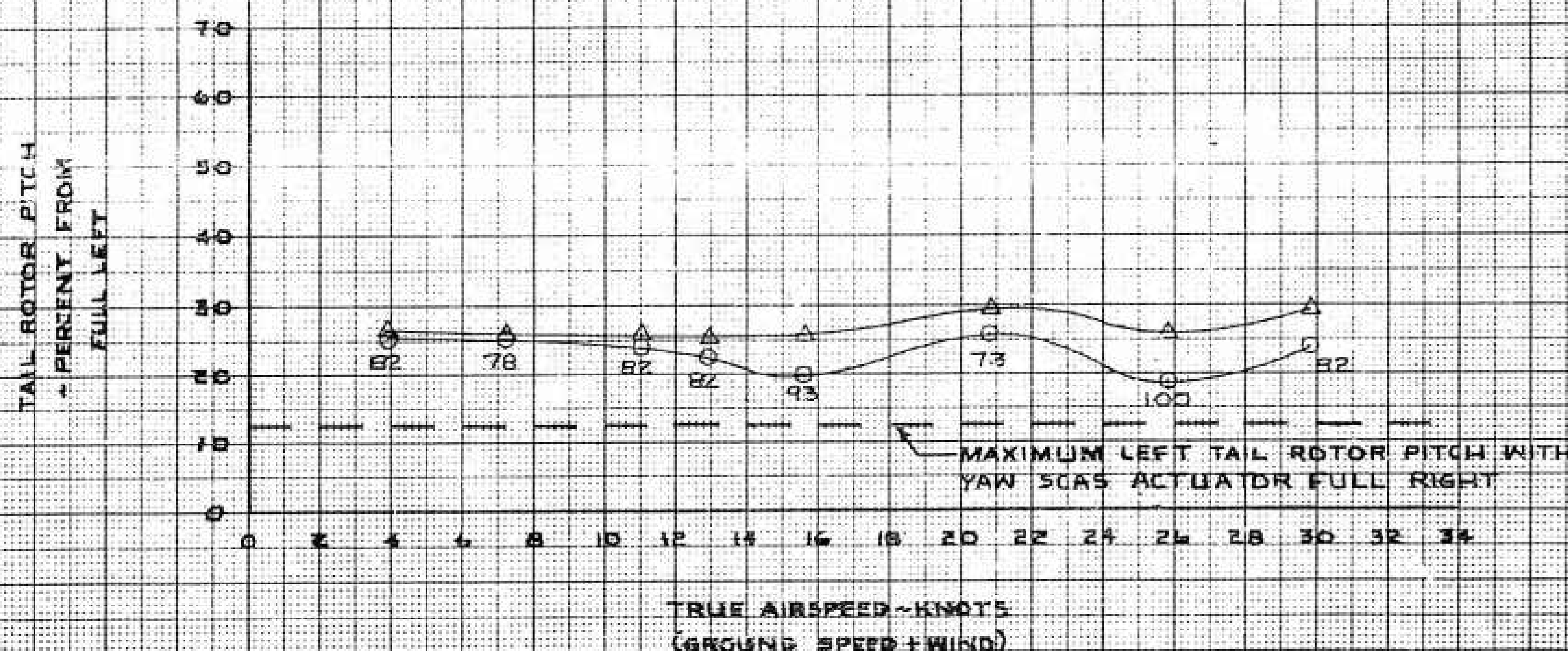
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



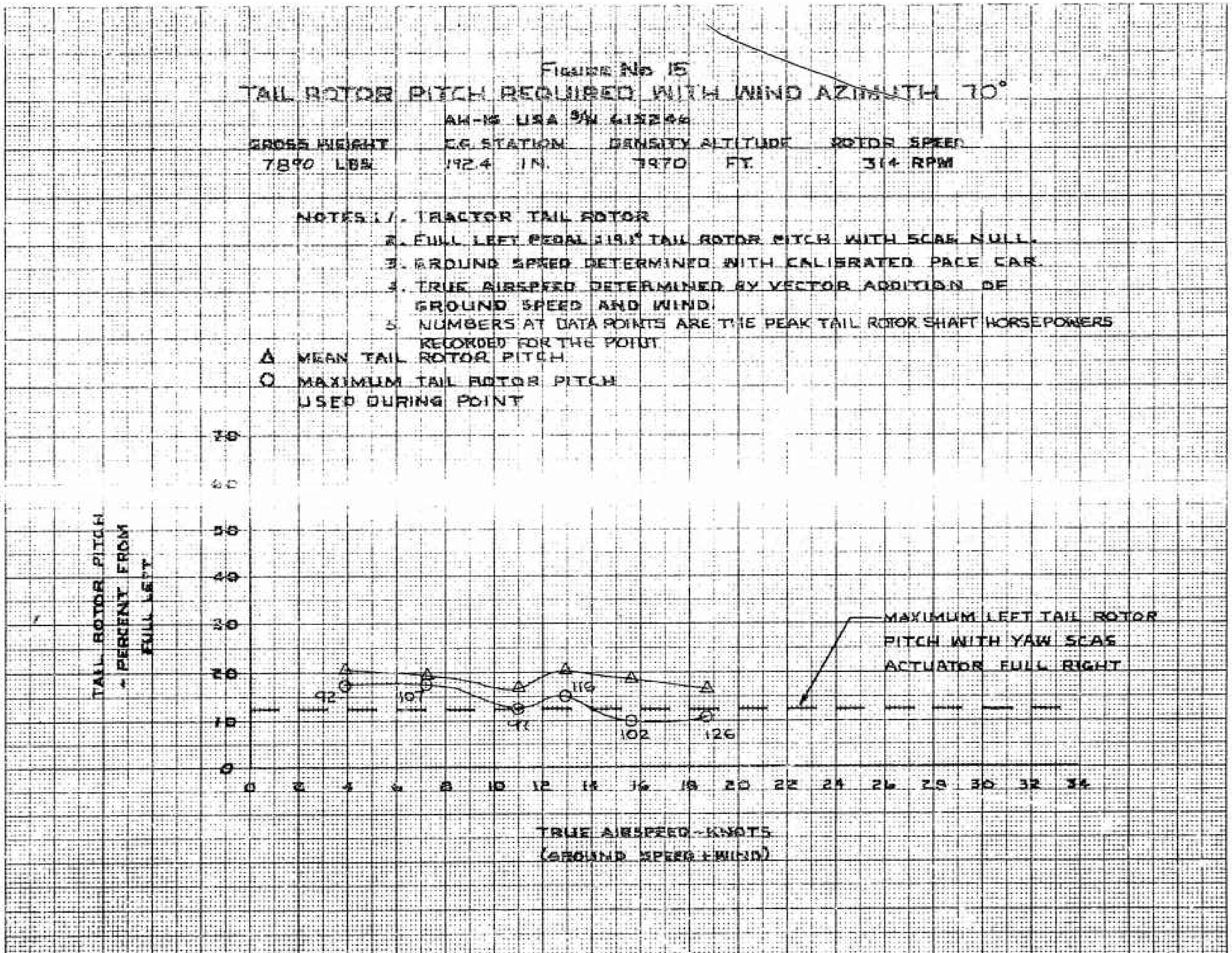


Figure No 15
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°
AH-1G USA S/N 615246
GROSS WEIGHT
7890 LBS
C.G. STATION
192.4 IN.
DENSITY ALTITUDE
7970 FT.
ROTOR SPEED
314 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
70
60
50
40
30
20
10
0
92
107
97
116
102
126
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
TRUE AIRSPEED - KNOTS
(GROUND SPEED + WIND)

FIGURE No 16

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8150 LBS	192.7 IN.	7970 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL ±19.1° TAIL ROTOR PITCH WITH SCAS NULL.

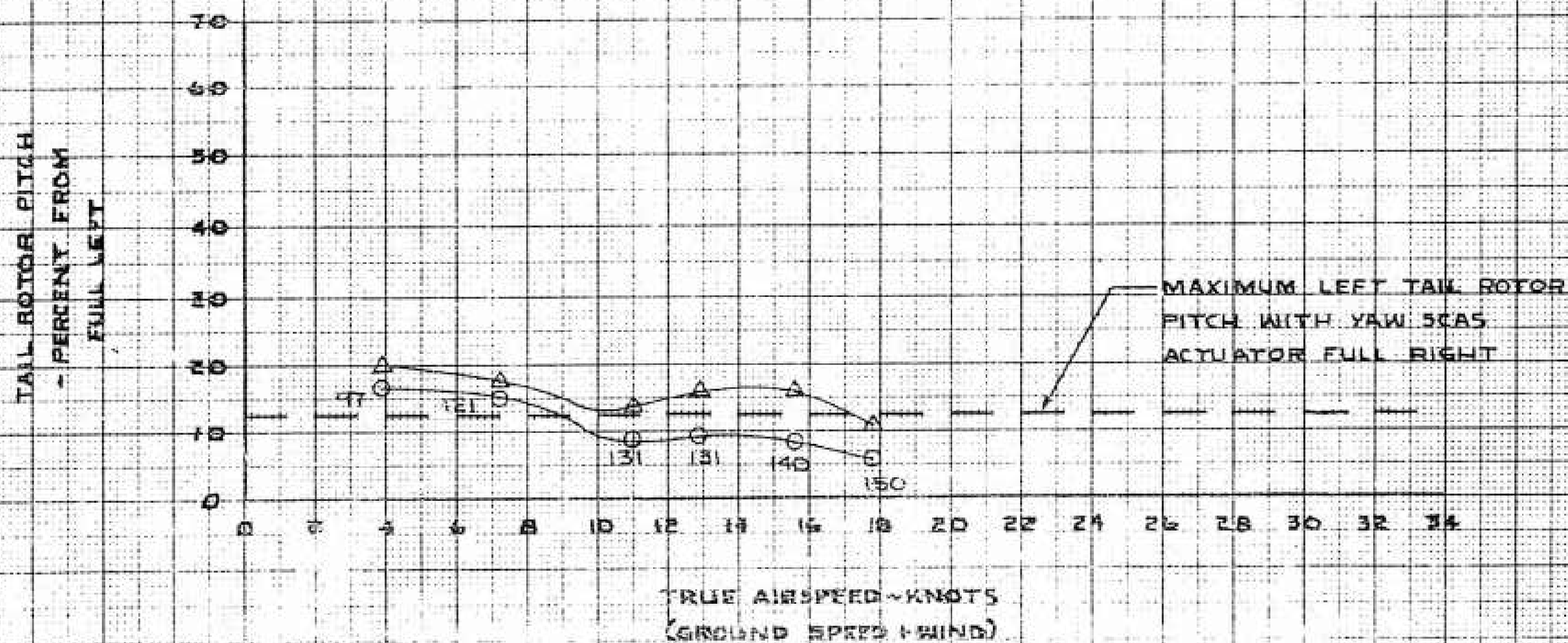
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



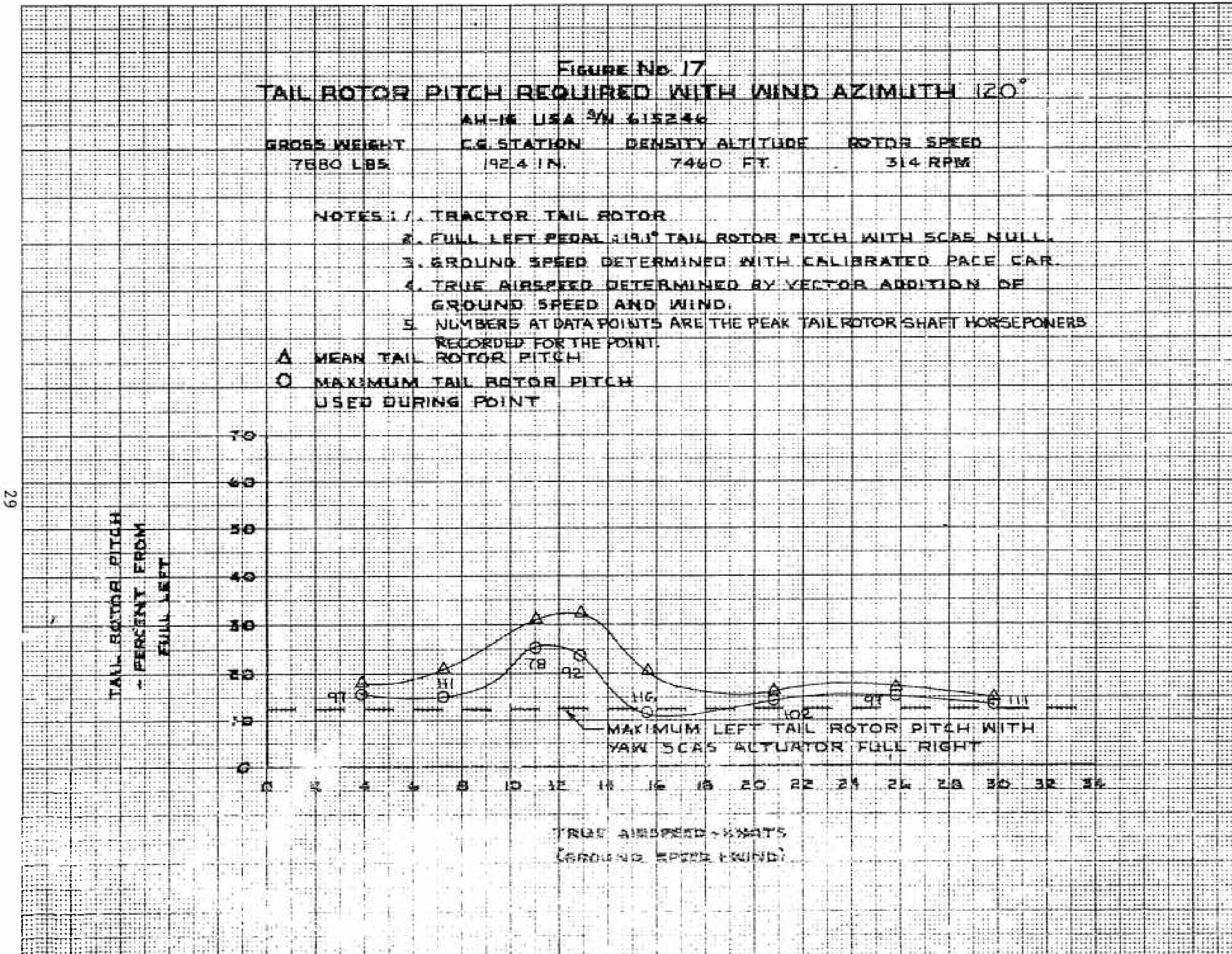


FIGURE No. 17
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 120°
AH-1G USA S/N 615246
GROSS WEIGHT
7680 LBS
C.G. STATION
192.4 IN.
DENSITY ALTITUDE
7460 FT
ROTOR SPEED
314 RPM
NOTES: 1. TRACTOR TAIL ROTOR.
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
TRUE AIRSPEED ~ KNOTS
(GROUND SPEED + WIND)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
97
111
78
92
116
102
97
111

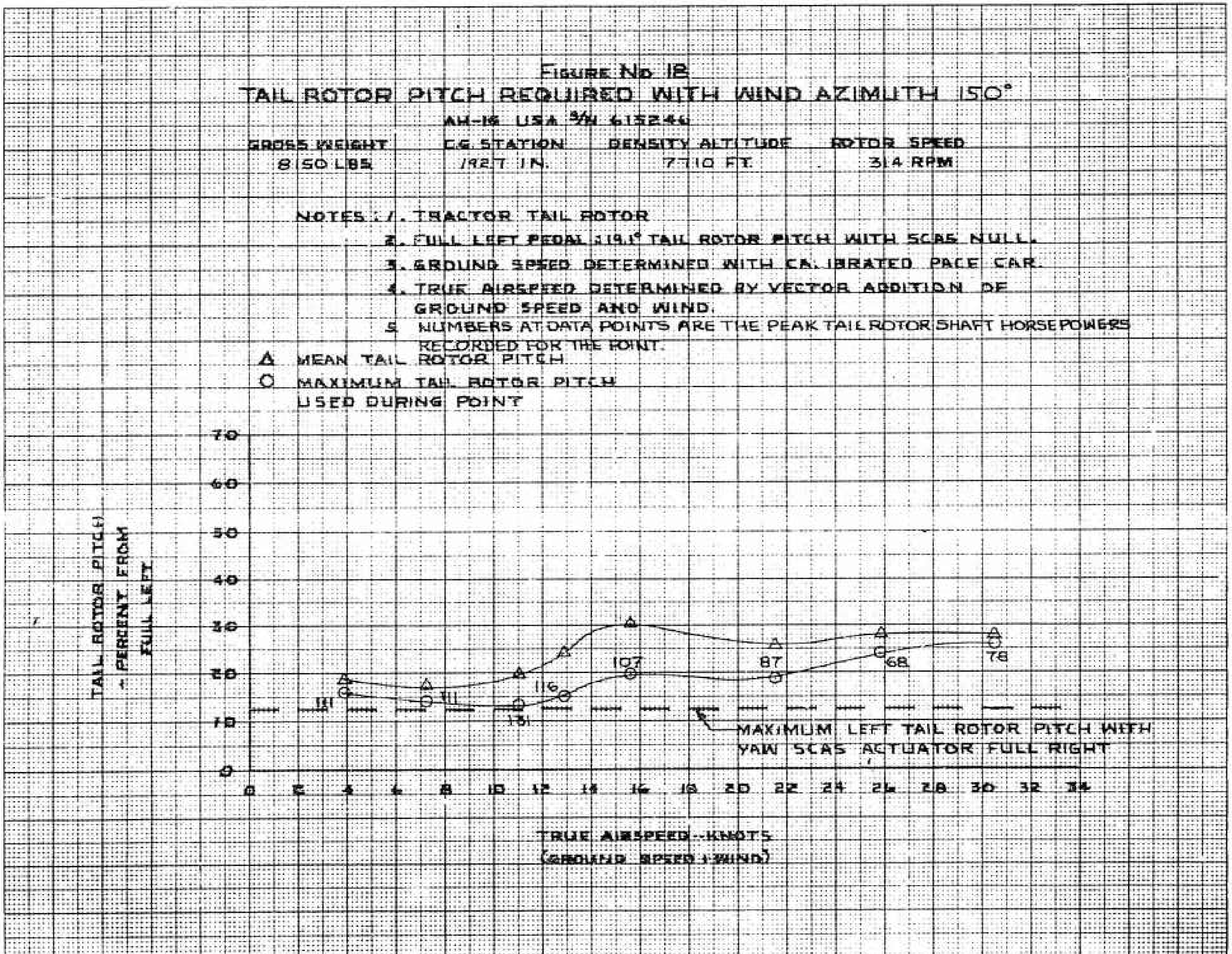


Figure No 18
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 150°
AH-1G USA S/N 615246
GROSS WEIGHT
8 50 LBS
C.G. STATION
1927 IN.
DENSITY ALTITUDE
7710 FT.
ROTOR SPEED
3 4 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL ≥19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH — PERCENT FROM FULL LEFT
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
131
111
131
116
107
87
68
78
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TRUE AIRSPEED — KNOTS
(GROUND SPEED + WIND)

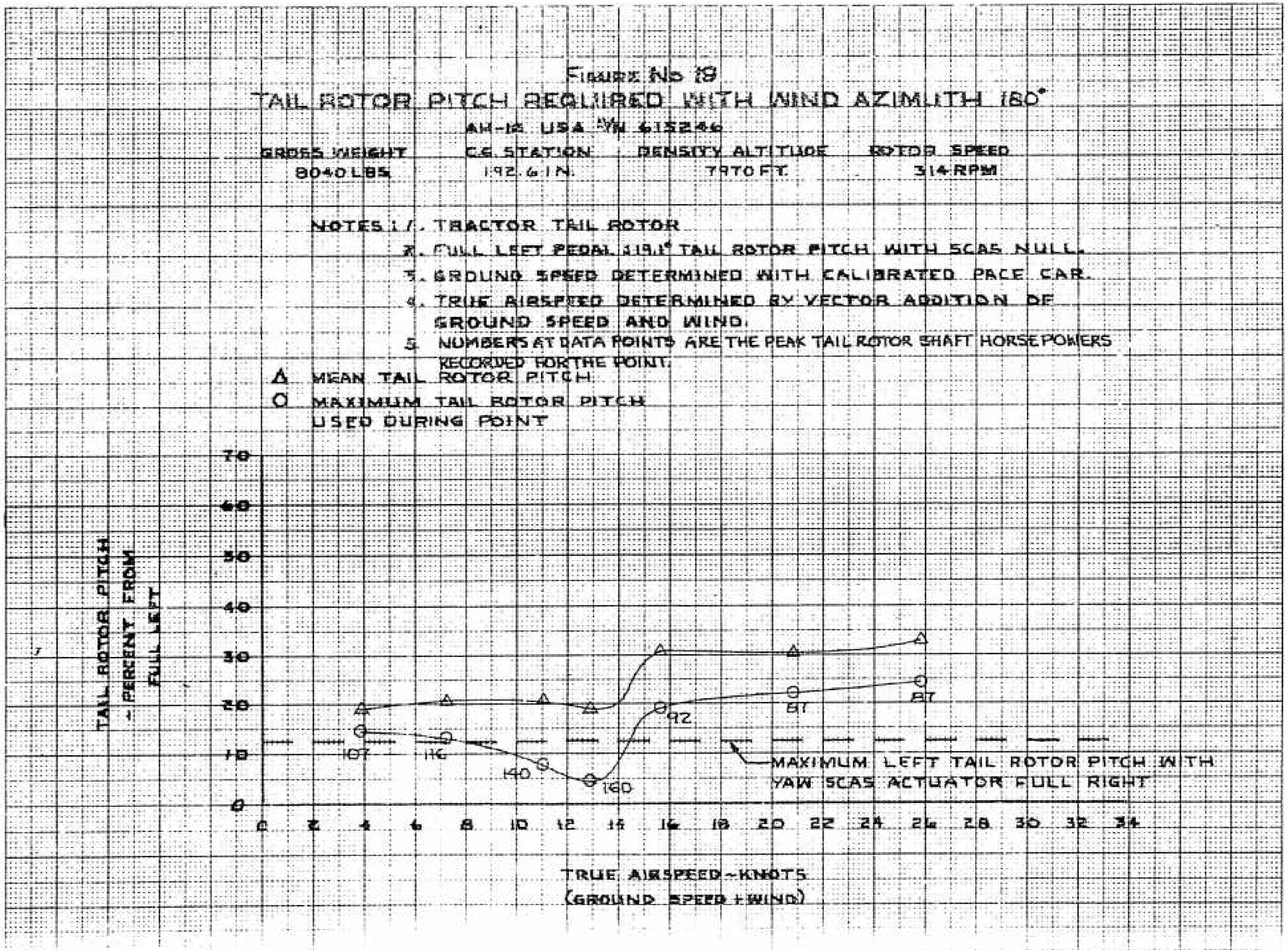


Figure No 18
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°
AH-1G USA S/N 615246
GROSS WEIGHT 8040 LBS
C.G. STATION 192.6 IN.
DENSITY ALTITUDE 7970 FT.
ROTOR SPEED 314 RPM
NOTES 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
0
10
20
30
40
50
60
70
107
116
140
160
92
87
87
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
TRUE AIRSPEED ~ KNOTS
(GROUND SPEED + WIND)

FIGURE No 20

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 210°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8100 LBS	192.6 IN.	1710 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL =19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

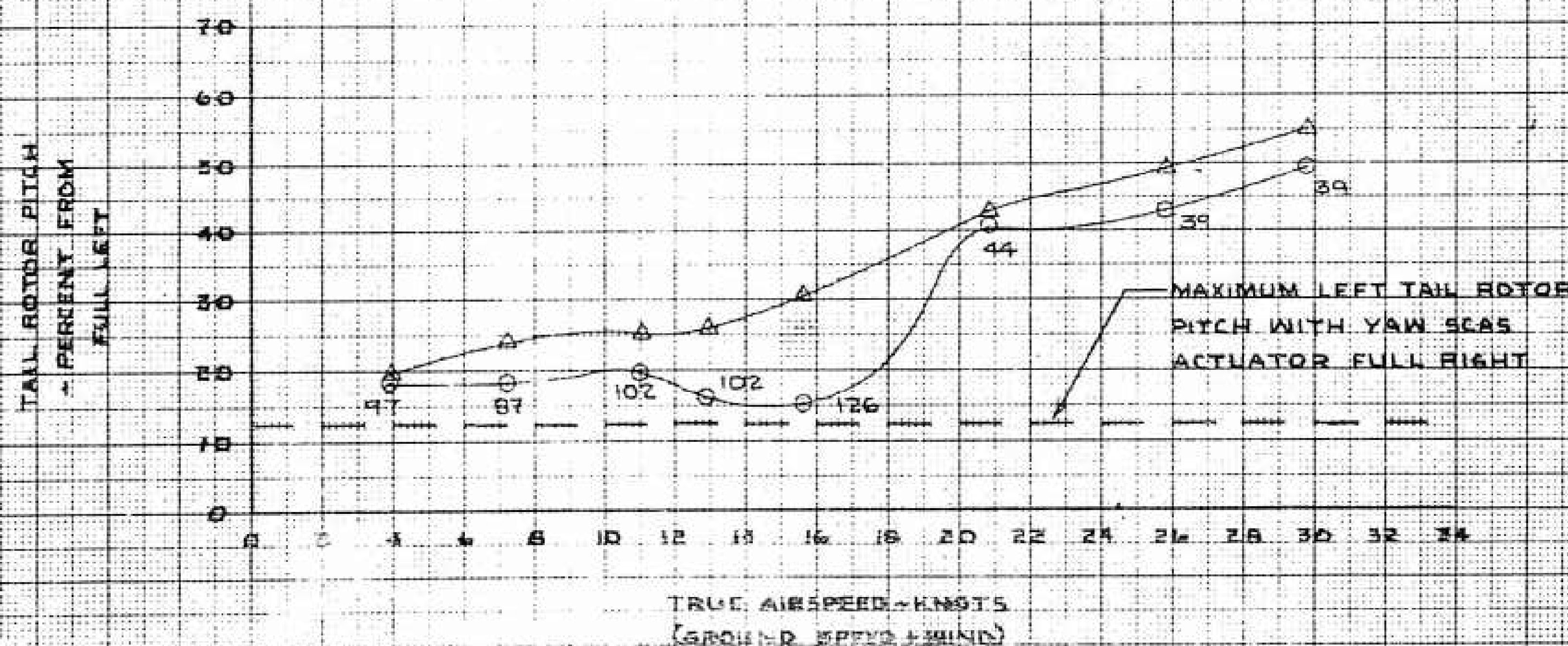


Figure No. 21

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 240°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8050 LBS	192.5 IN.	7710 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.

3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

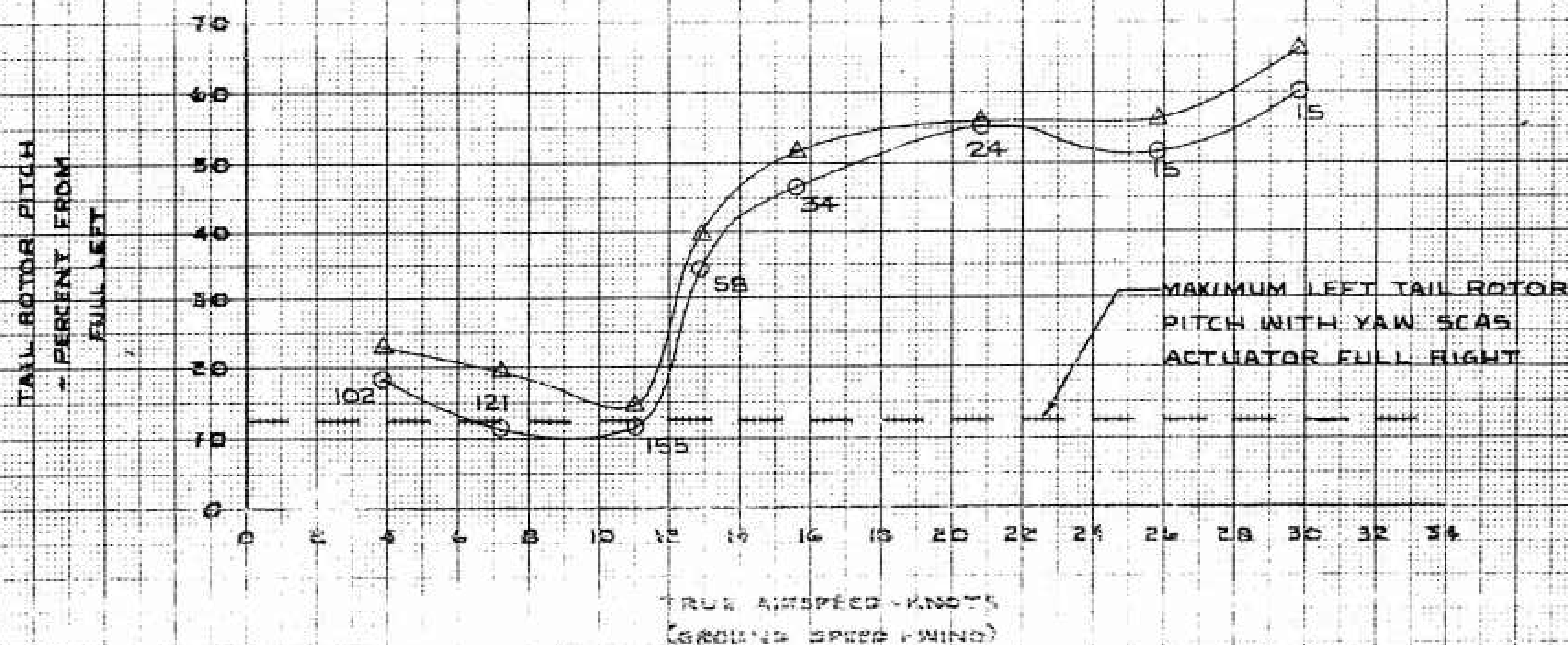


FIGURE No 22
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 270°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7930 LBS	192.5 IN.	7970 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

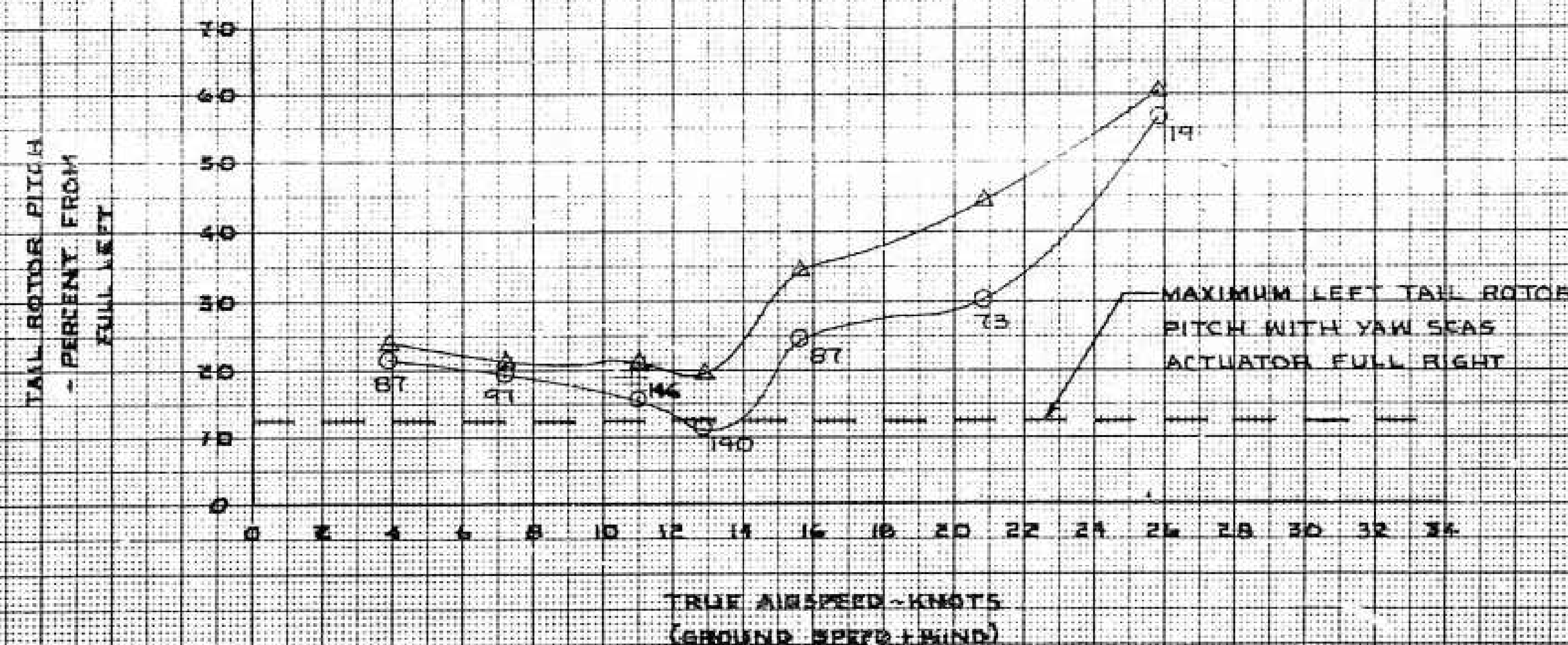


Figure No. 23

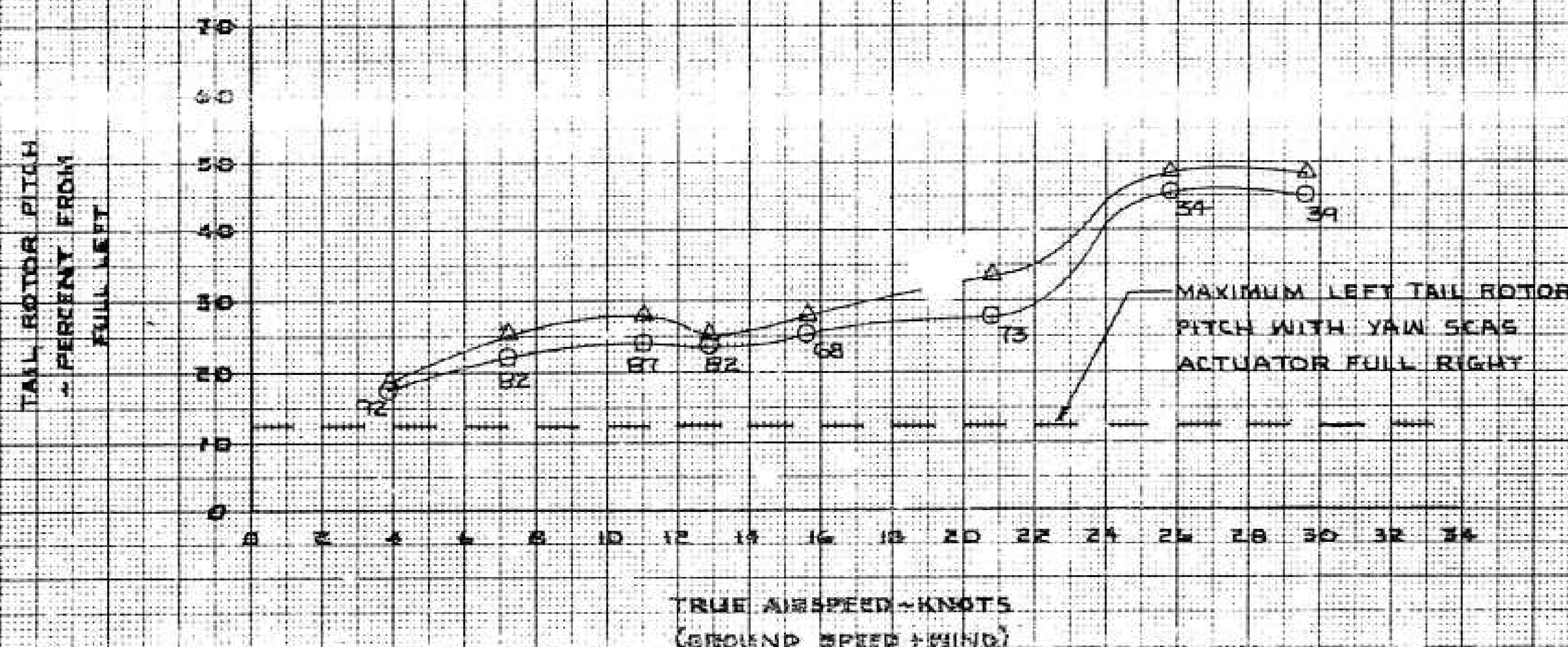
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 315°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8000 LBS	192.4 IN.	7710 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.2° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



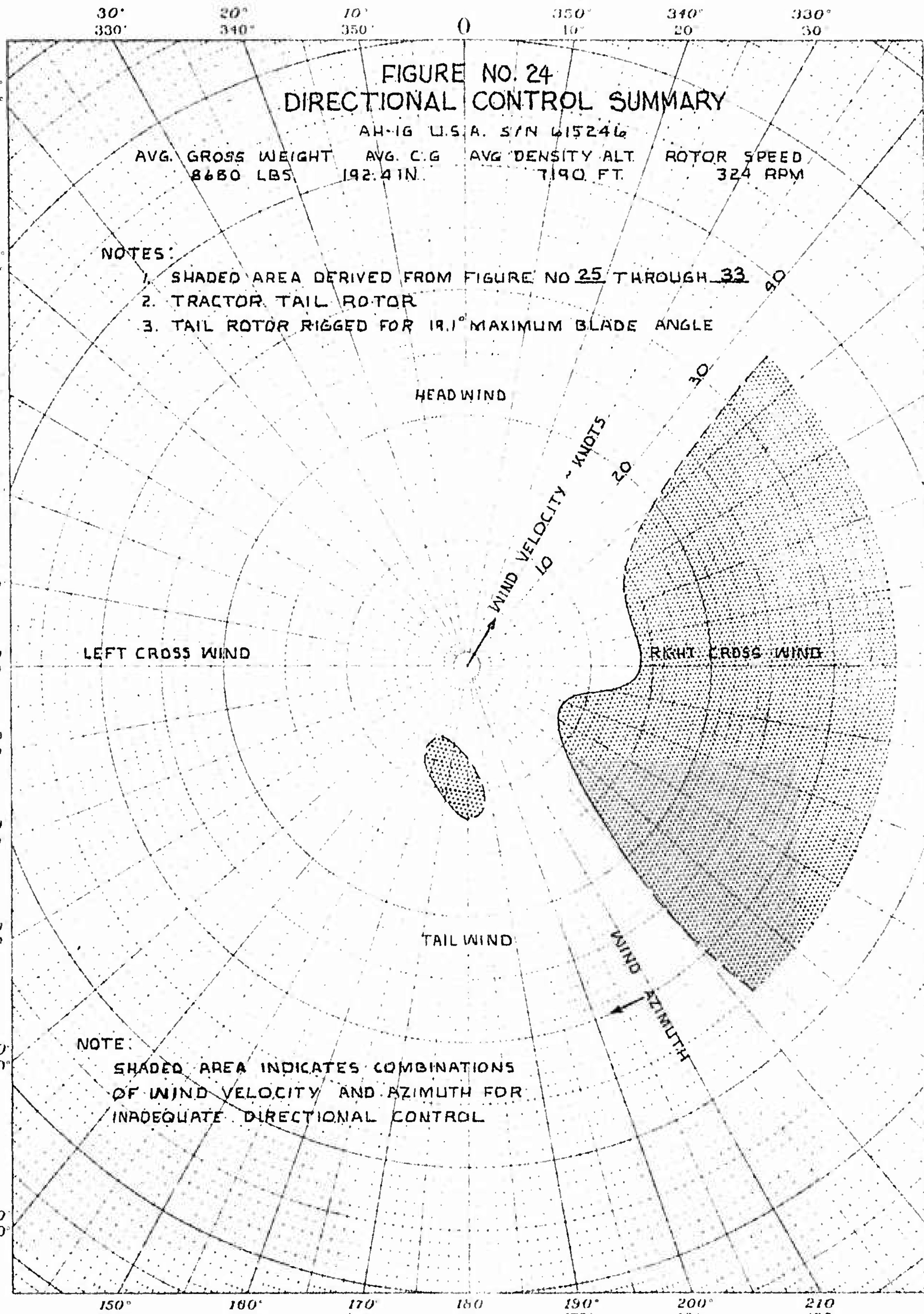


FIGURE NO. 24
DIRECTIONAL CONTROL SUMMARY
AH-1G U.S.A. S/N 615246
AVG. GROSS WEIGHT 8680 LBS.
AVG. C.G 192.4 IN.
AVG DENSITY ALT. 7190 FT.
ROTOR SPEED 324 RPM
NOTES:
1. SHADED AREA DERIVED FROM FIGURE NO 25 THROUGH 33
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE
HEAD WIND
WIND VELOCITY ~ KNOTS
10
20
30
40
LEFT CROSS WIND
RIGHT CROSS WIND
TAIL WIND
WIND AZIMUTH
NOTE:
SHADED AREA INDICATES COMBINATIONS OF WIND VELOCITY AND AZIMUTH FOR INADEQUATE DIRECTIONAL CONTROL
0
10° 350°
20° 340°
30° 330°
350° 10°
340° 20°
330° 30°
40° 320°
320° 40°
310°
310° 50°
60 300
300° 60°
70 290°
290 70°
80 280°
280 80°
90 0
270 90°
100 260
260° 100°
110 250
120 240
240 120
130° 230°
230 130°
140° 220°
220° 140°
150° 210°
160° 200°
170° 190°
180 180
190° 170°
200° 160°
210 150

Figure No. 25

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 35°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8710 LBS	192.4 IN.	7600 FT.	324 RPM

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

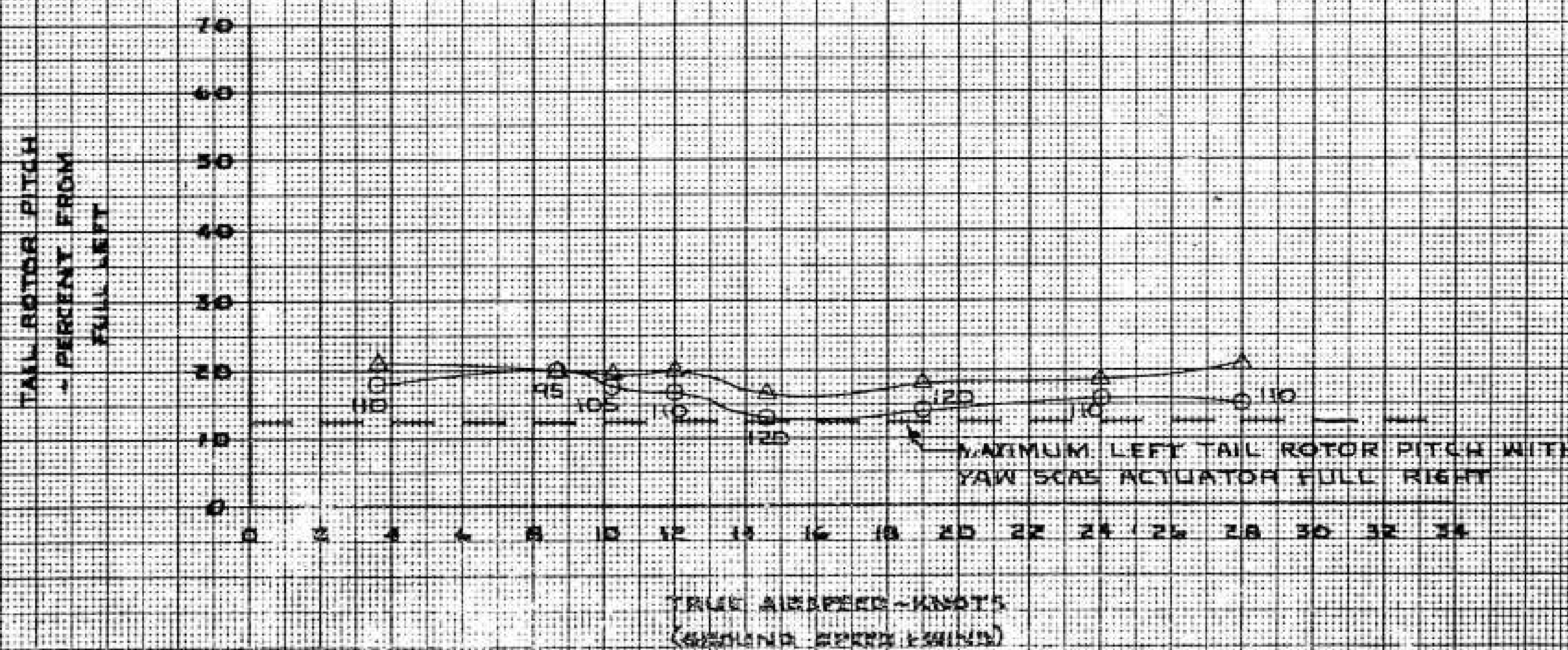


FIGURE No 26

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 65°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8700 LBS	192.5 IN.	7260 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

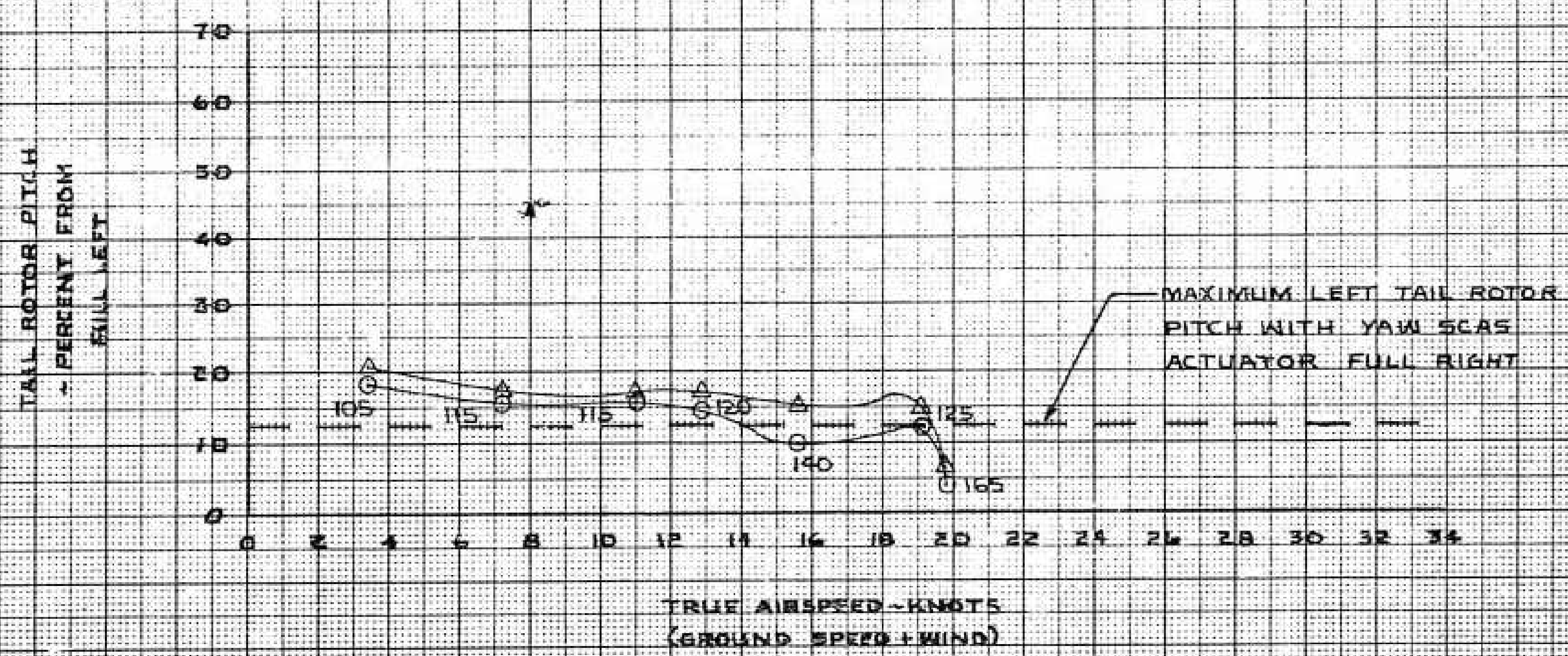


Figure No 27

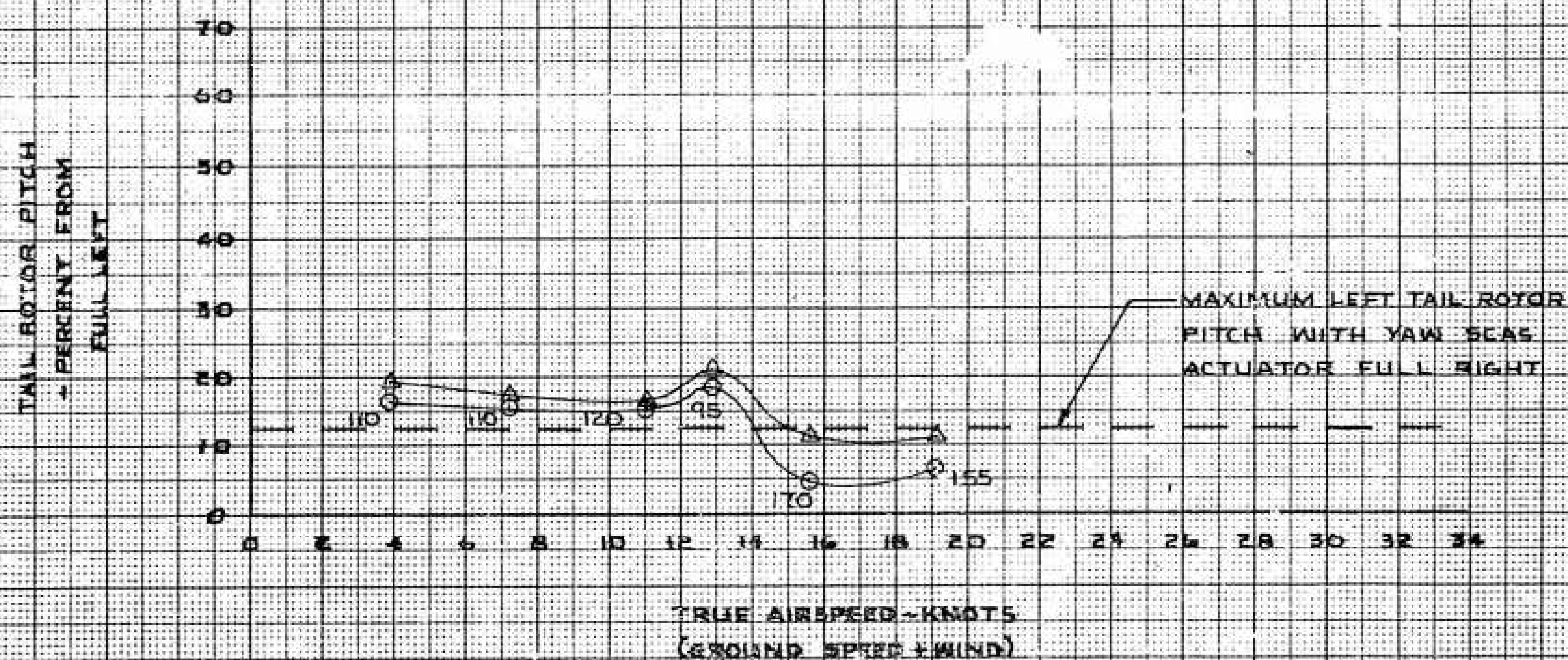
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8660 LBS	192.3 IN.	6810 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



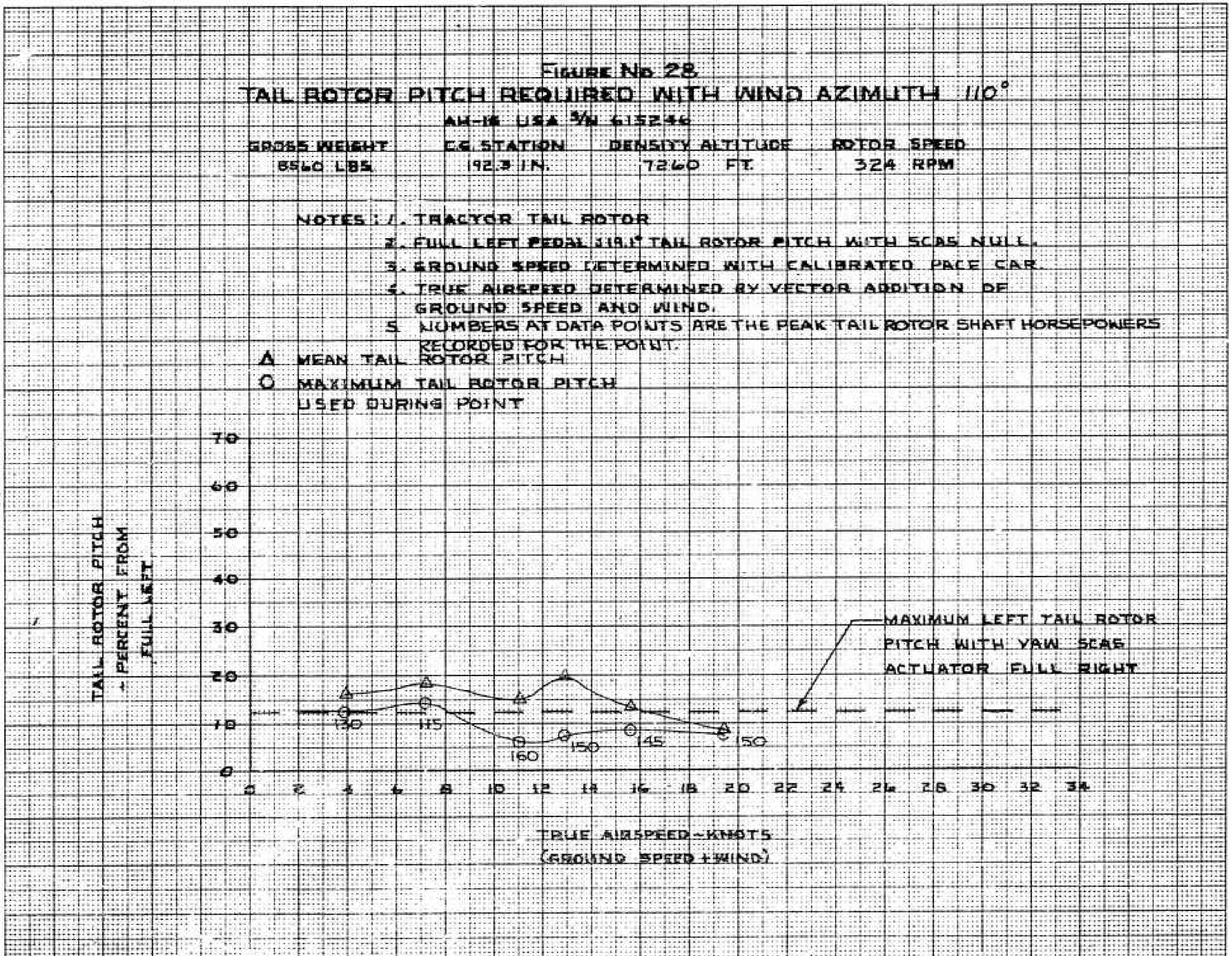


FIGURE No 28
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 110°
AH-1G USA S/N 615246
GROSS WEIGHT 8560 LBS.
C.G. STATION 192.3 IN.
DENSITY ALTITUDE 7260 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
Δ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)
0 10 20 30 40 50 60 70
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
130
115
160
150
145
150

FIGURE No 29

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 140°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8780 LBS	192.5 IN.	7600 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL ±19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

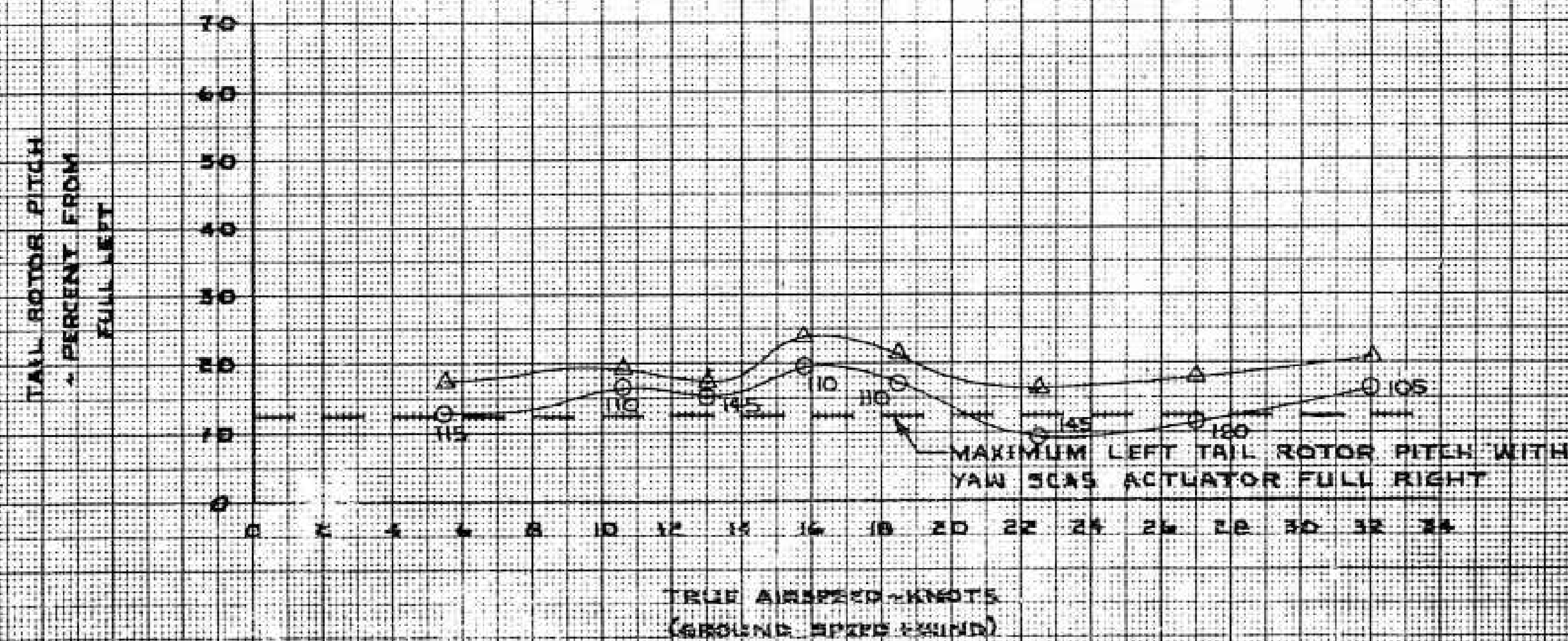


FIGURE No. 30

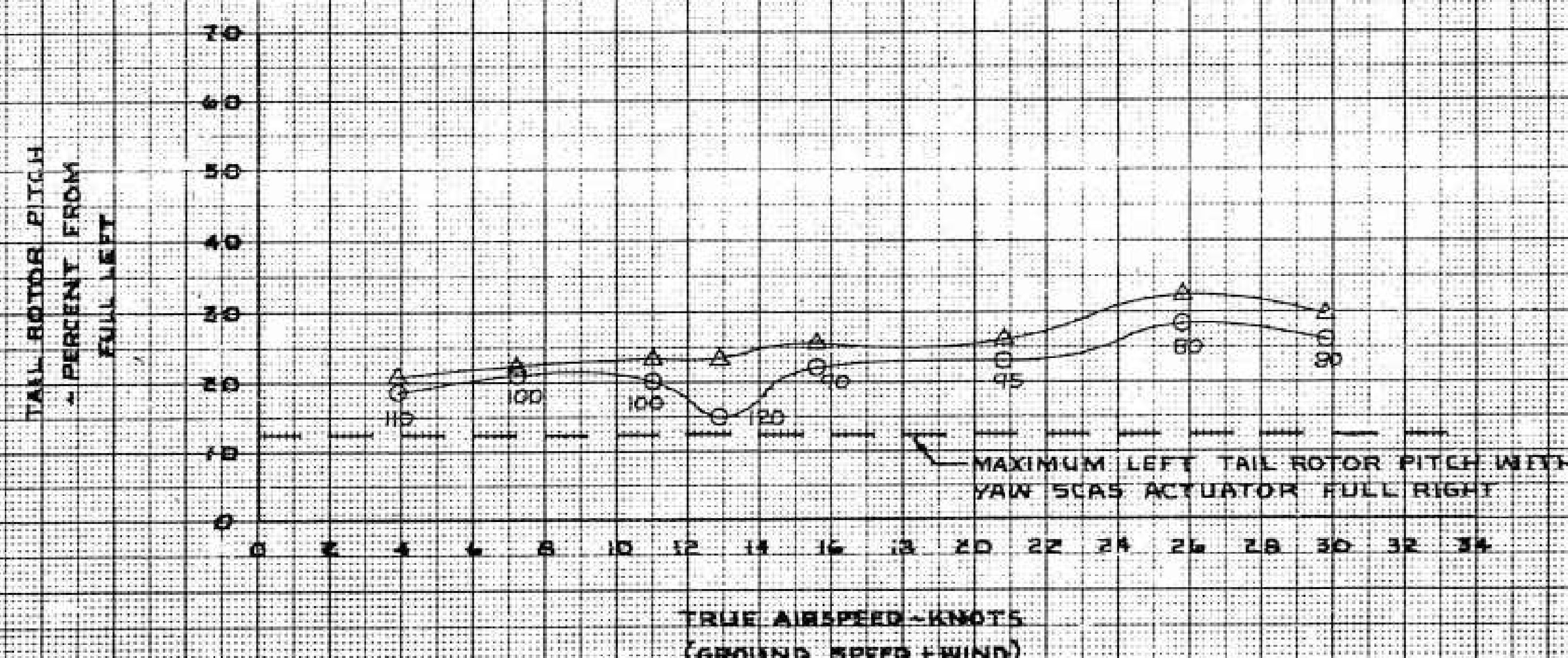
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 160°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8610 LBS	192.4 IN.	7260 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL (19.1° TAIL ROTOR PITCH) WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



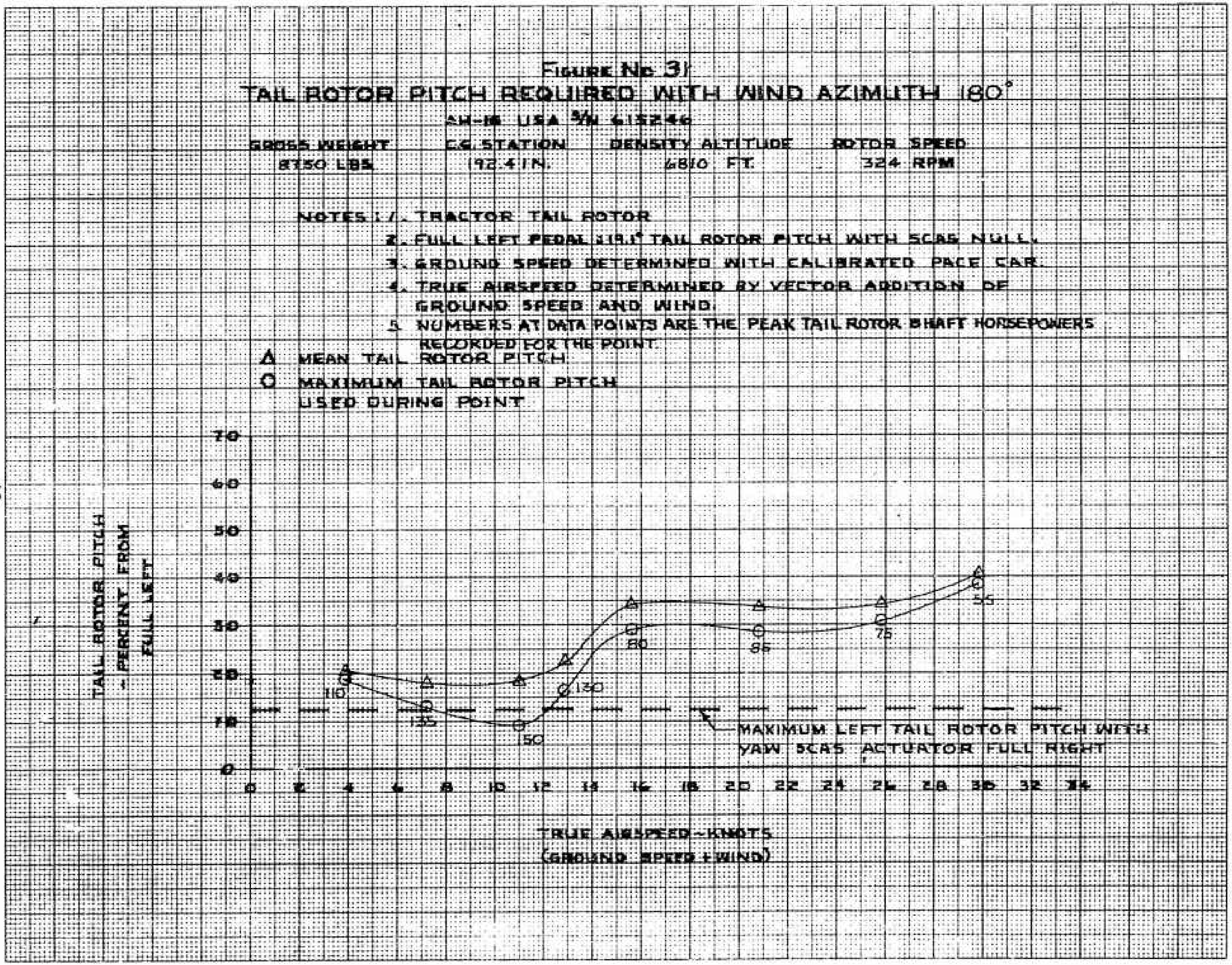


FIGURE No 31
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°
AH-1G USA S/N 615246
GROSS WEIGHT 8750 LBS
C.G. STATION 192.4 IN.
DENSITY ALTITUDE 6810 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL ±19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
70
60
50
40
30
20
10
0
110
135
150
130
80
85
75
55
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
TRUE AIRSPEED - KNOTS
(GROUND SPEED + WIND)

Figure No 32

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 200°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8580 LBS	192.2 IN.	4810 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

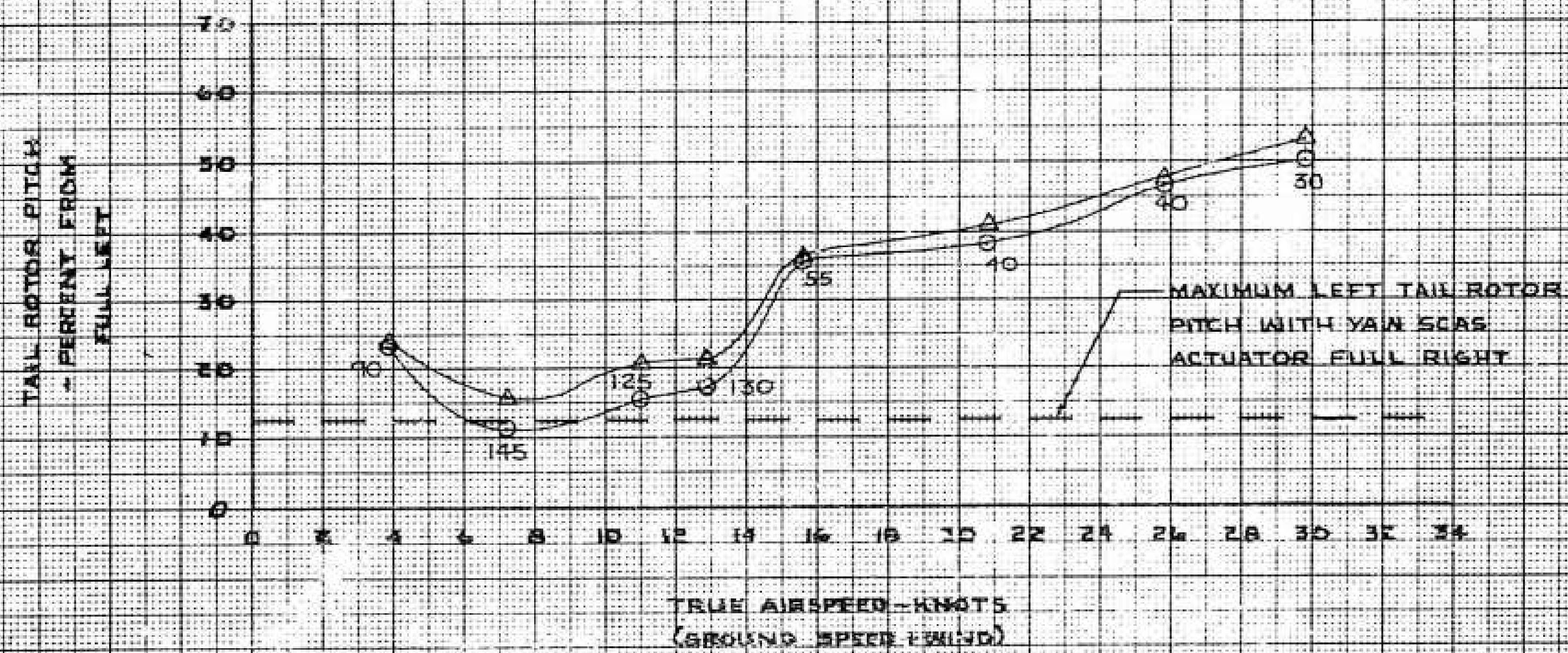


Figure No 33

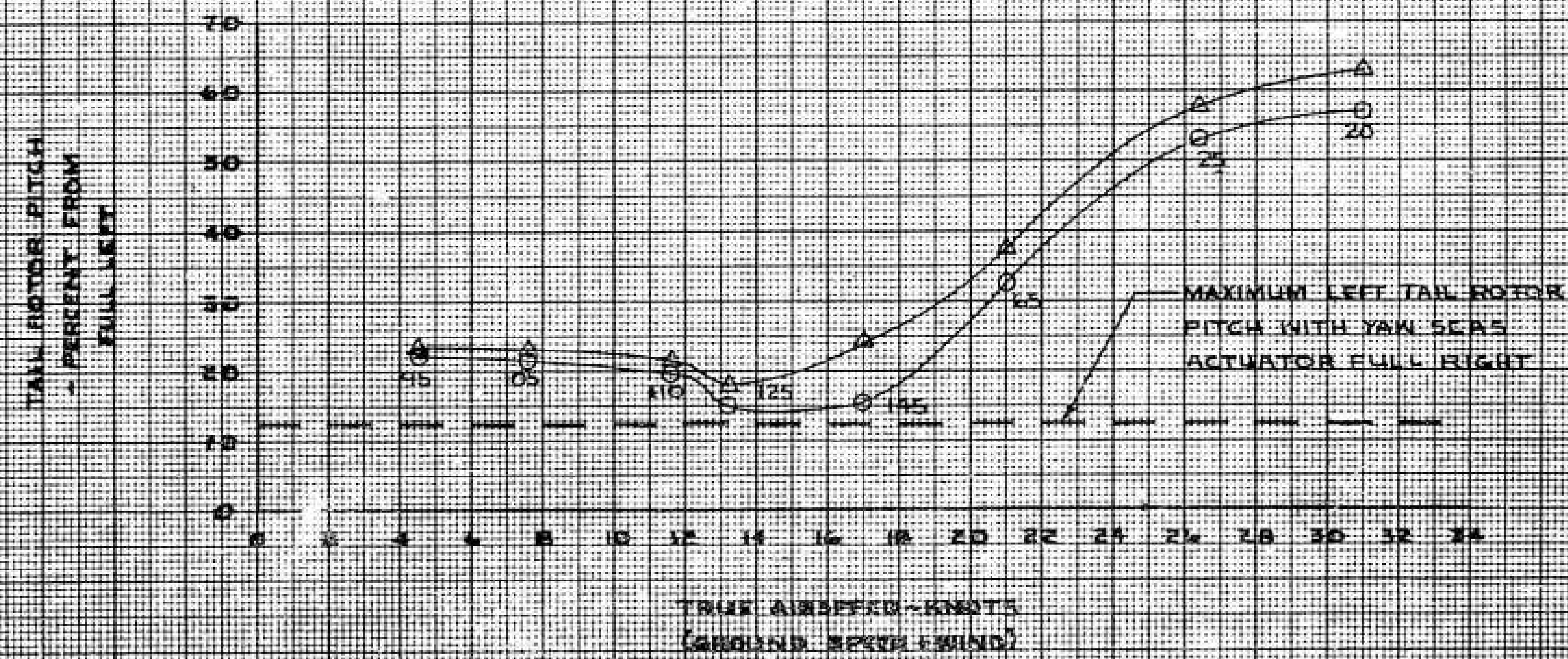
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 280°

AH-1K USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8770 LBS	192.6 IN.	7260 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



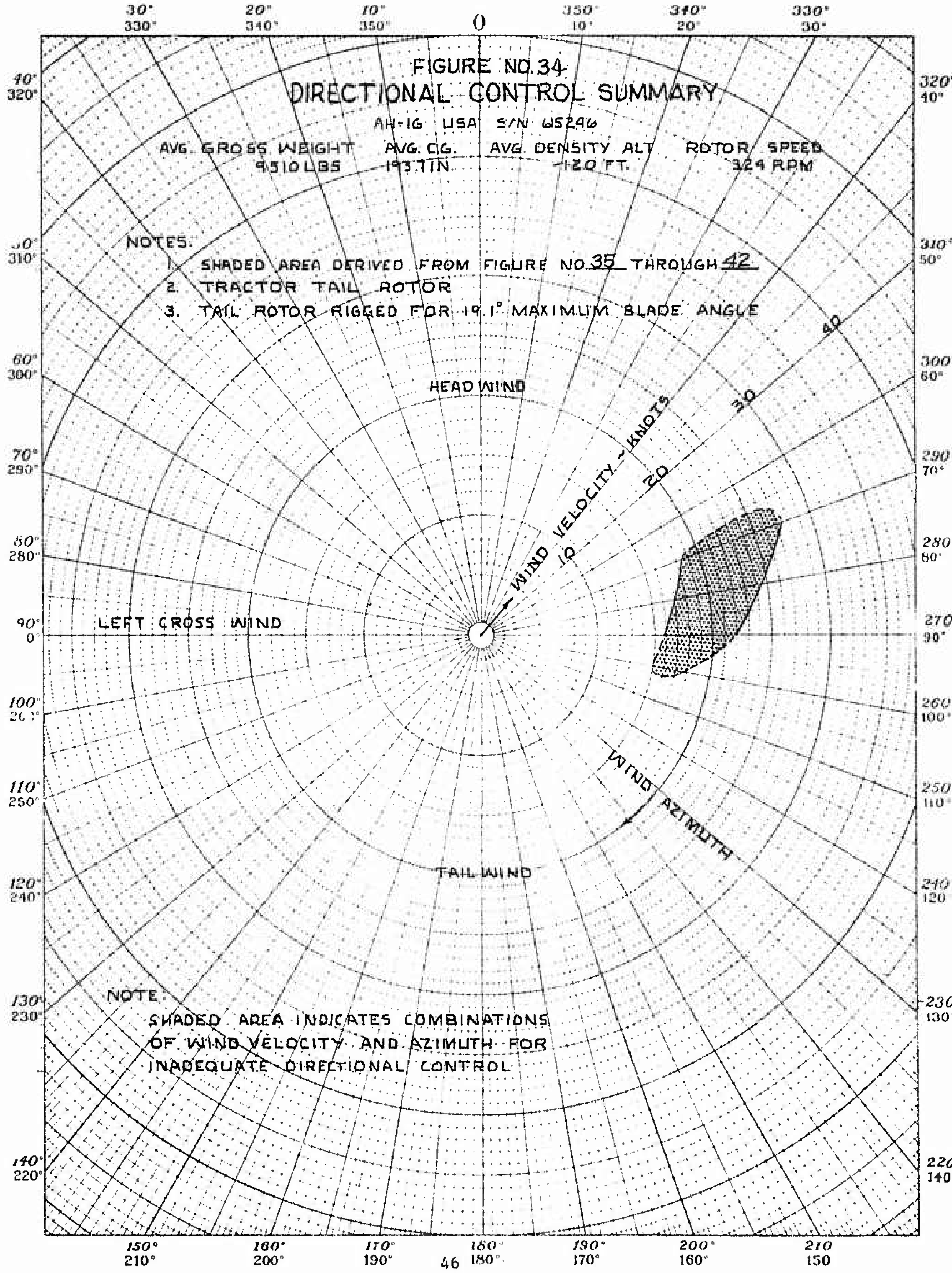


FIGURE NO.34
DIRECTIONAL CONTROL SUMMARY
AH-1G USA S/N 65246
AVG. GROSS WEIGHT 9510 LBS
AVG. C.G. 193.7 IN.
AVG. DENSITY ALT -120 FT.
ROTOR SPEED 324 RPM
NOTES:
1. SHADED AREA DERIVED FROM FIGURE NO. 35 THROUGH 42
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE
HEAD WIND
LEFT CROSS WIND
TAIL WIND
WIND VELOCITY ~ KNOTS
10
20
30
40
WIND AZIMUTH
NOTE:
SHADED AREA INDICATES COMBINATIONS OF WIND VELOCITY AND AZIMUTH FOR INADEQUATE DIRECTIONAL CONTROL

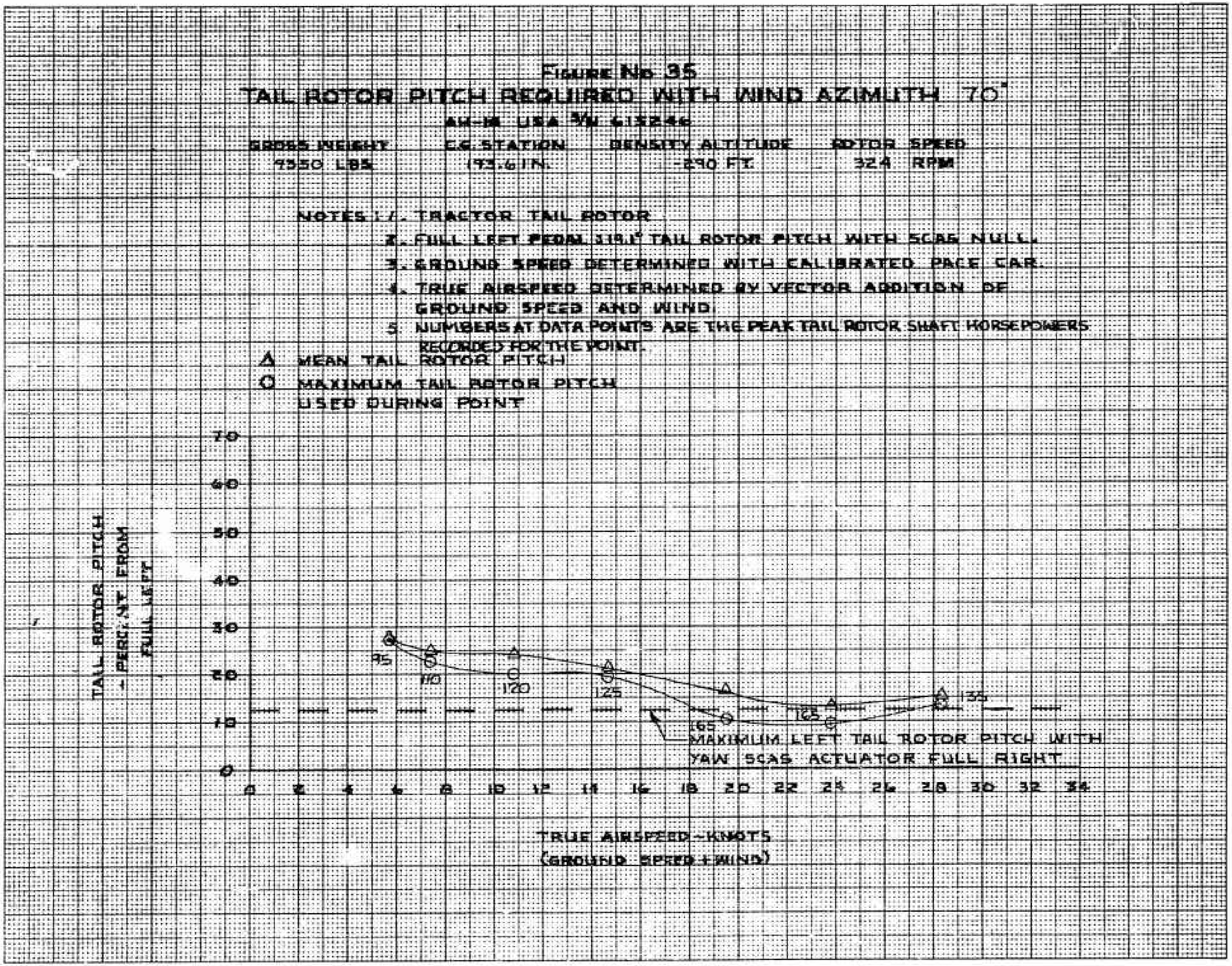


Figure No 35
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°
AH-1G USA S/N 615246
GROSS WEIGHT 7550 LBS
C.G. STATION 193.6 IN.
DENSITY ALTITUDE -290 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 118.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
0
10
20
30
40
50
60
70
95
110
120
125
165
165
135
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
TRUE AIRSPEED - KNOTS
(GROUND SPEED + WIND)

FIGURE No. 36

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9570 LBS	193.9 IN.	-290 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR.
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

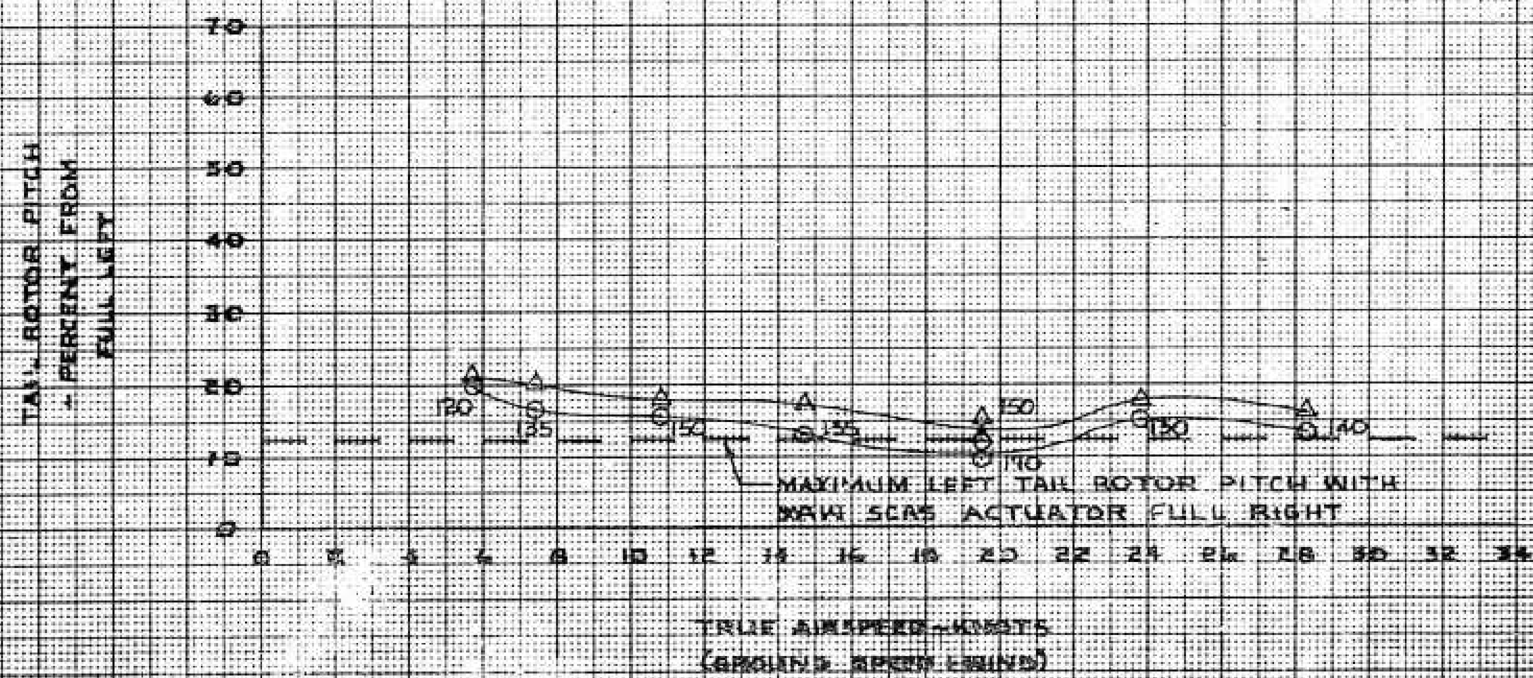


FIGURE No 37

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 110°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9490 LBS	193.8 IN.	-290 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL (19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

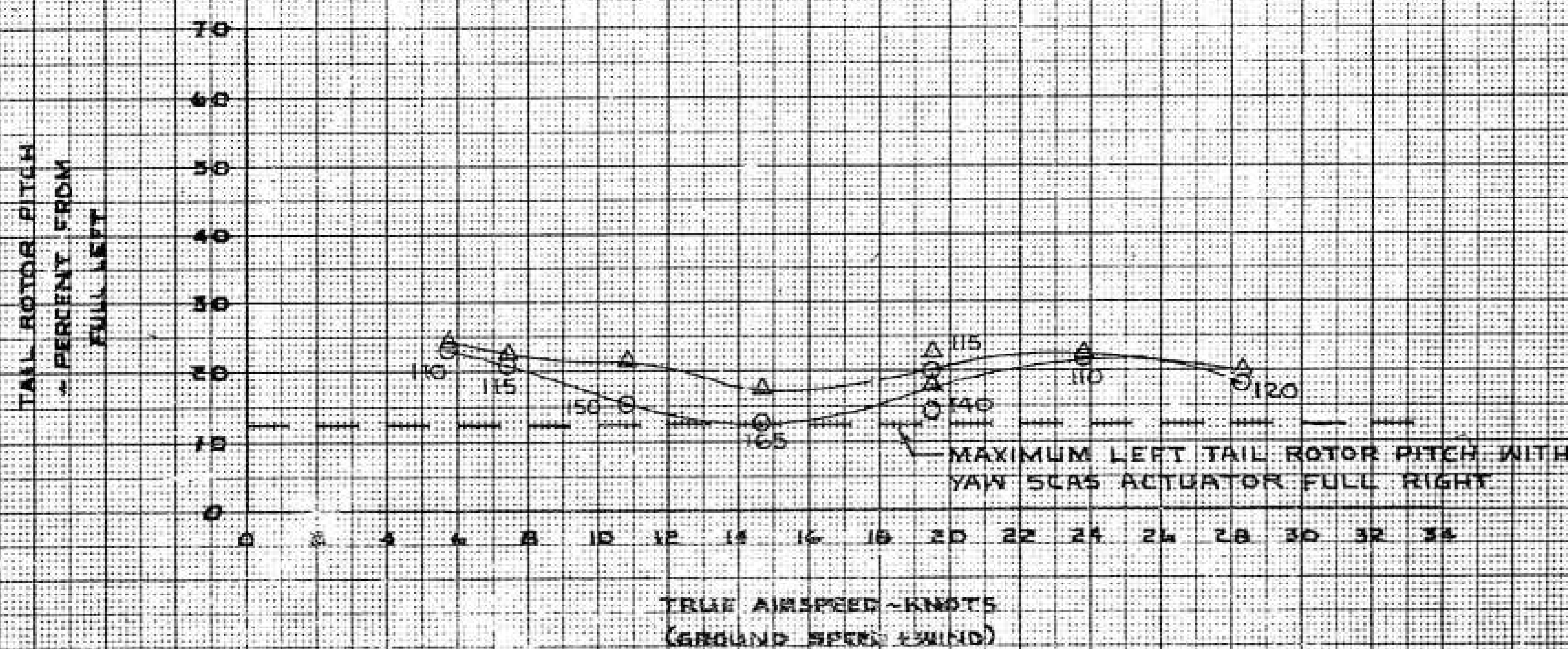


FIGURE No 38

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 130°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9460 LBS	193.5 IN.	60 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT THE DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

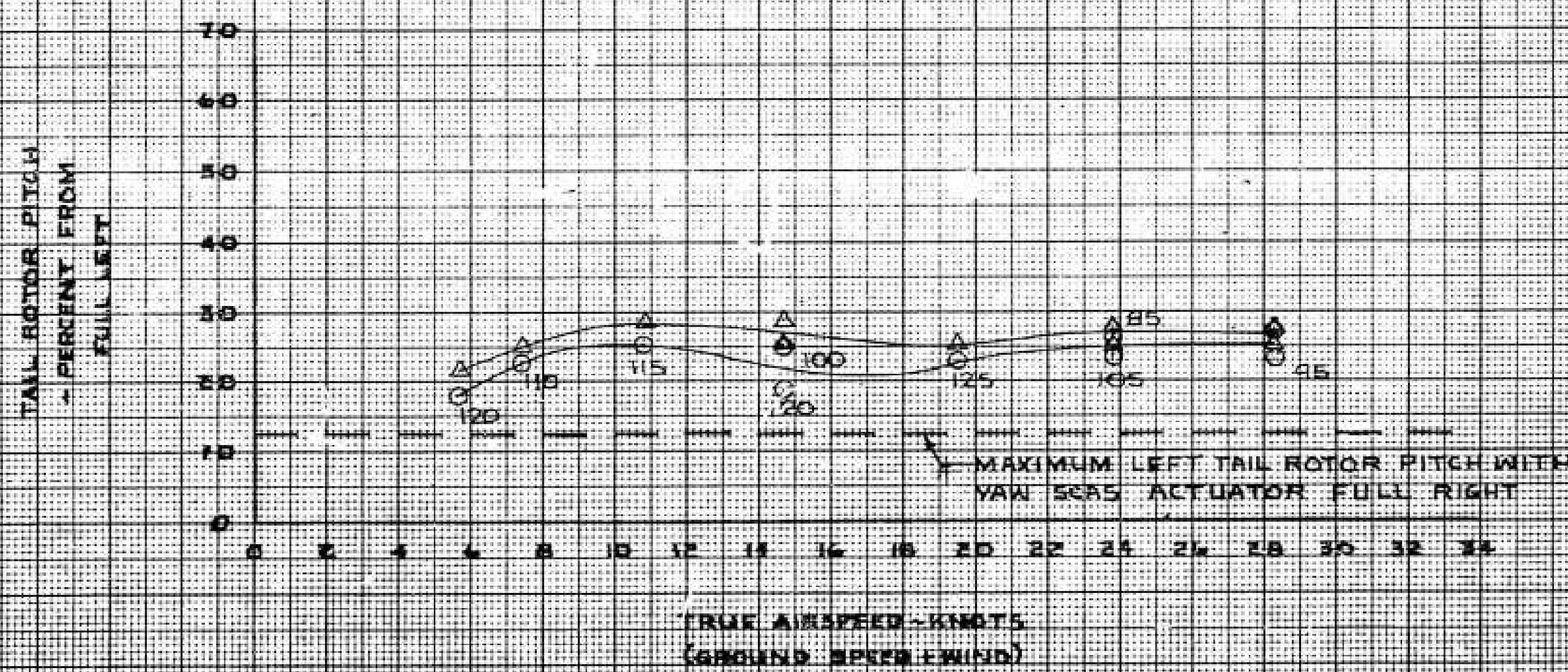


FIGURE No 39

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 160°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9660 LBS	193.8 IN.	60 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 319.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

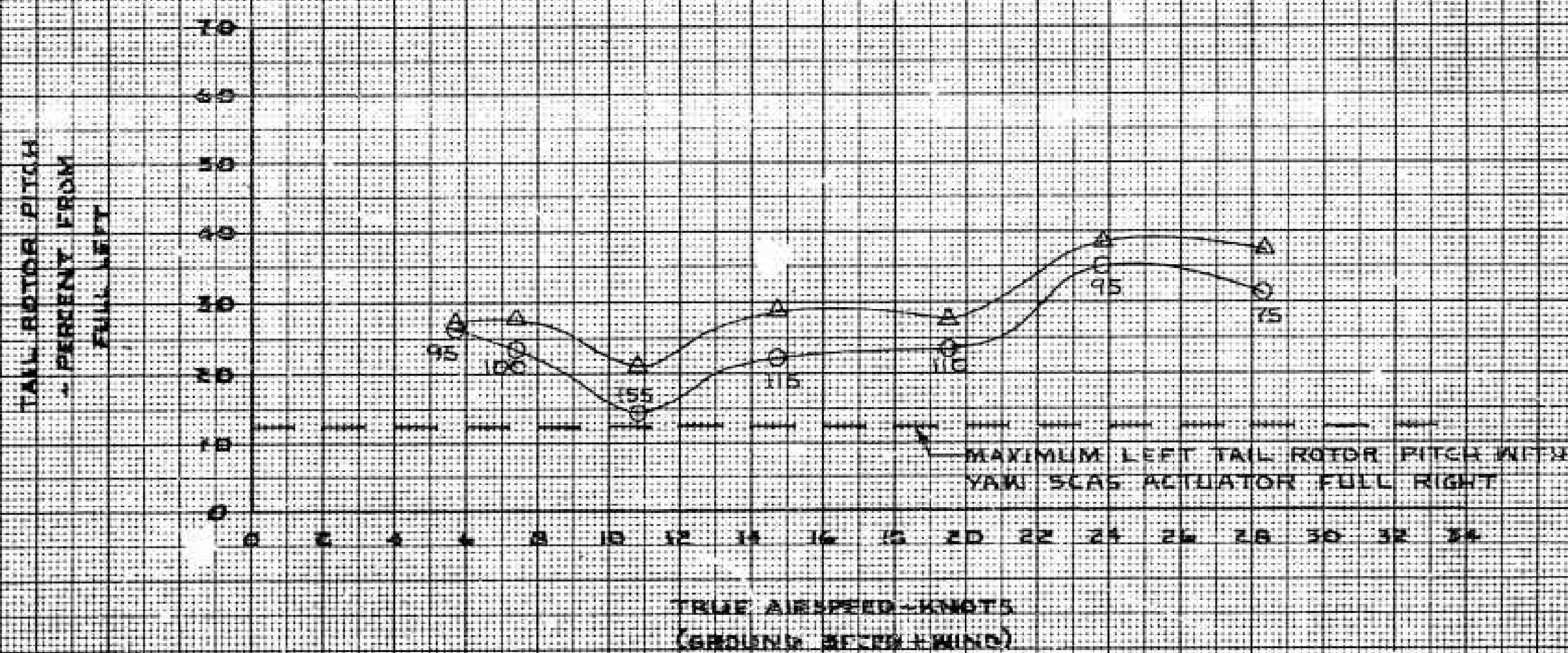


FIGURE No 40

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9420 LBS	193.7 IN.	-290 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL 119.5° TAIL ROTOR PITCH WITH SCAS NULL.

3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

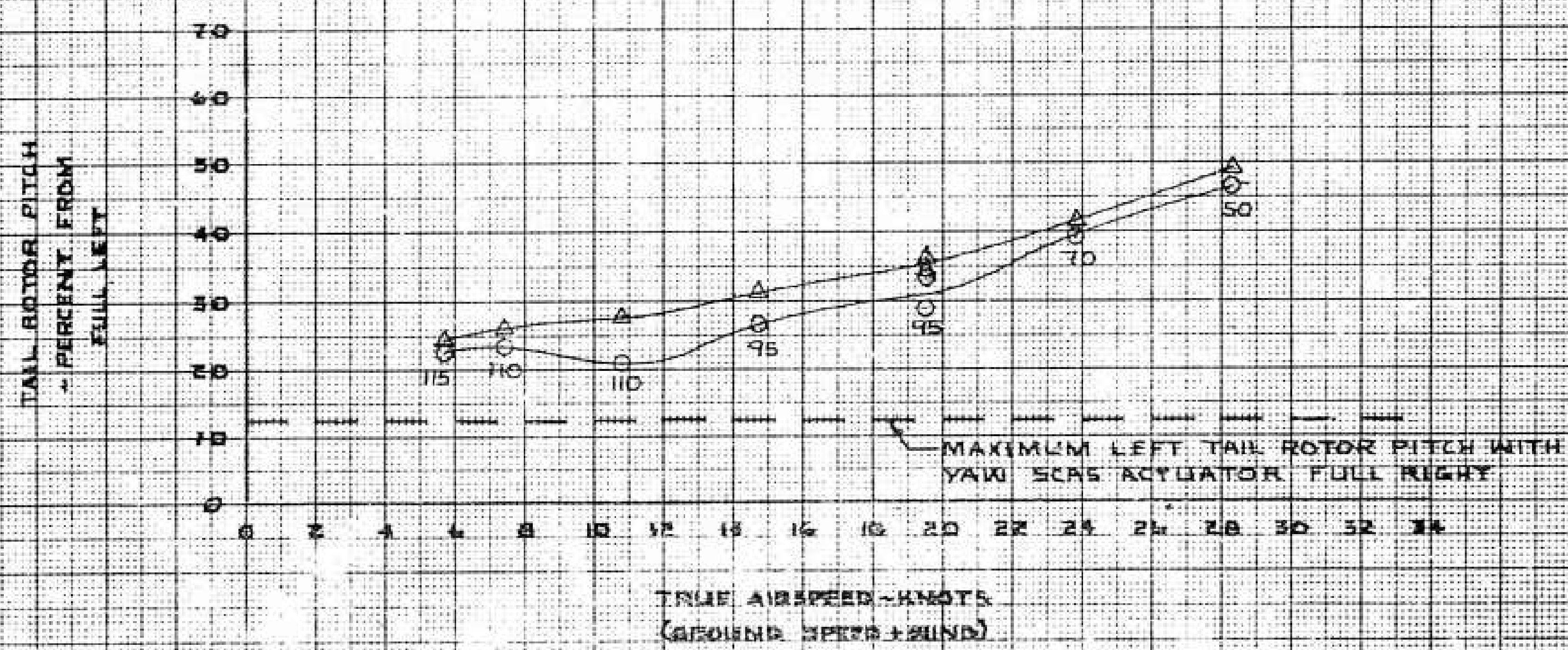


FIGURE NO. 41

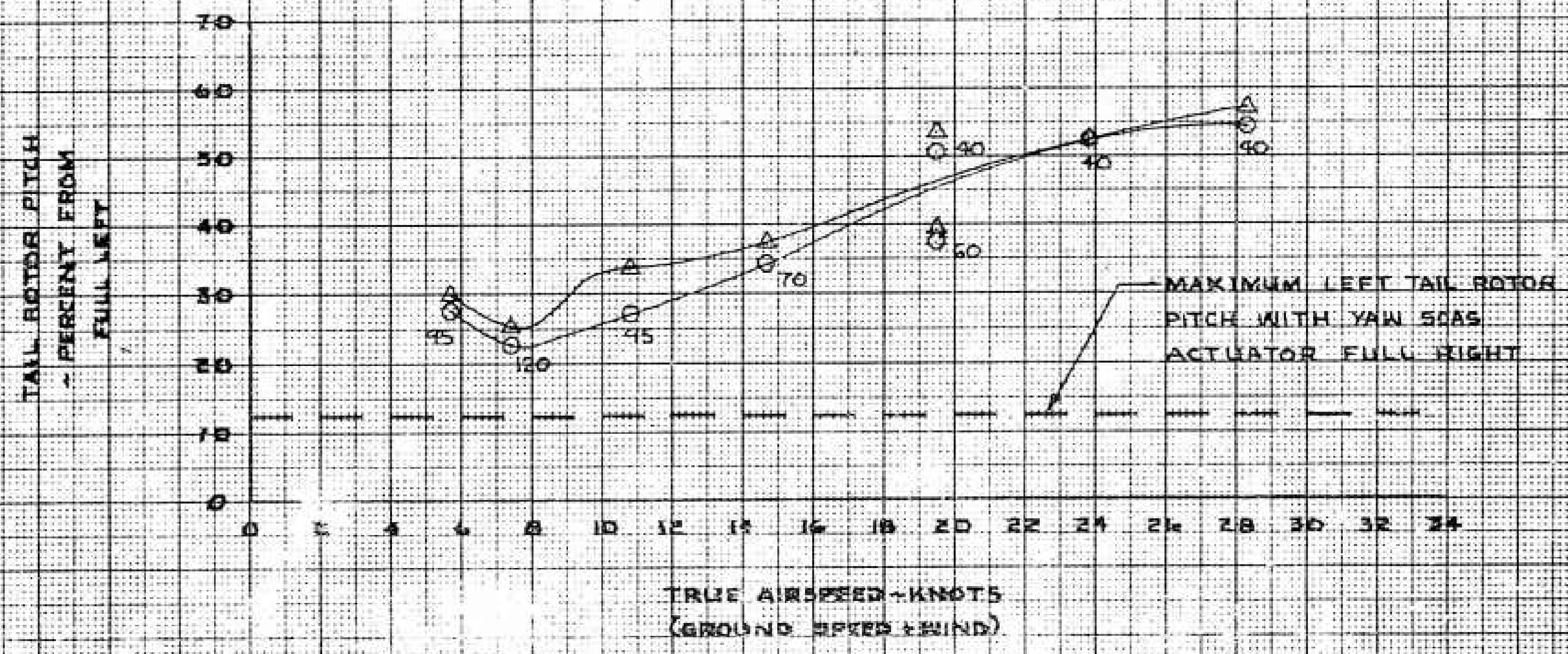
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 200°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9600 LBS.	193.7 IN.	60 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



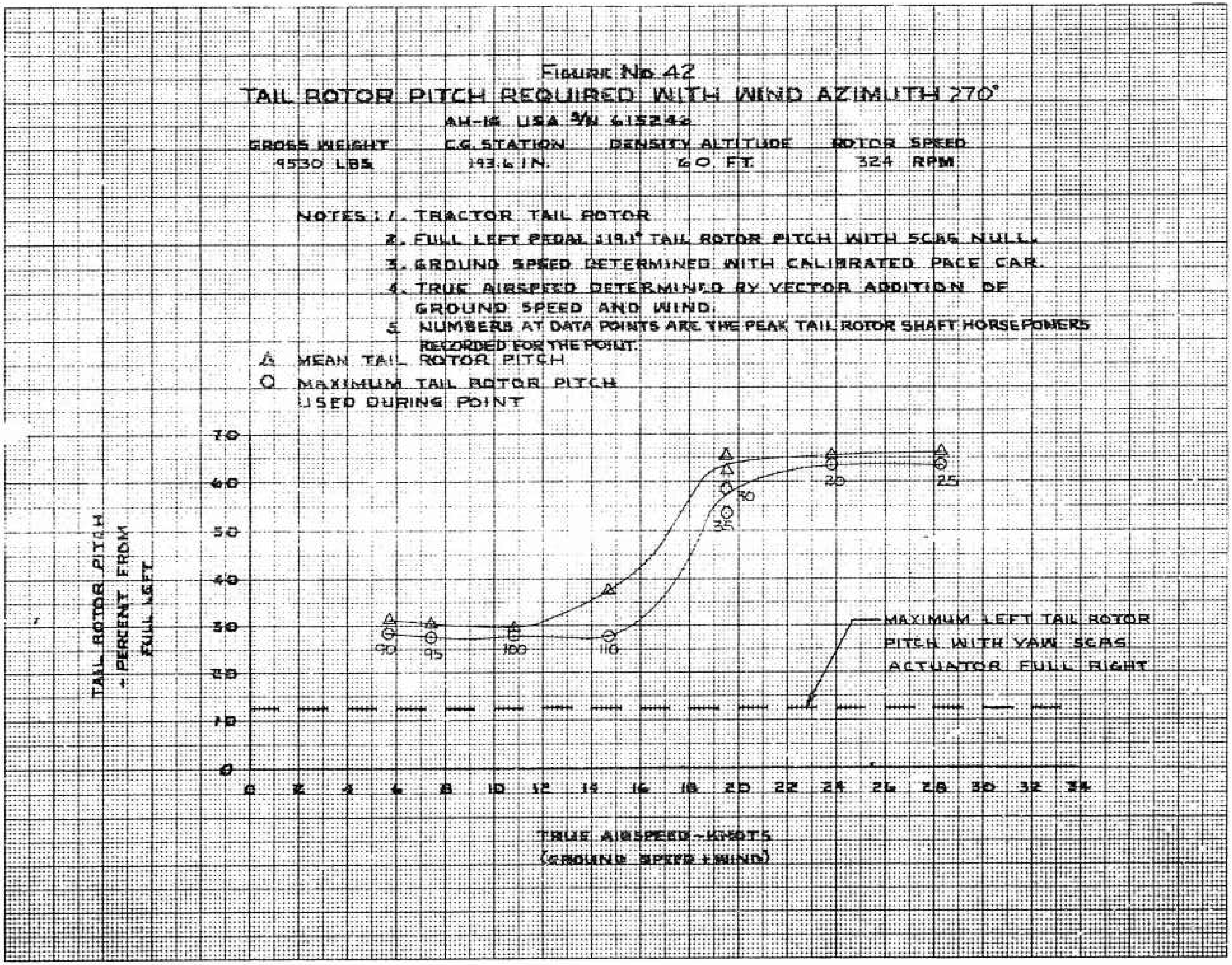


FIGURE No 42
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 270°
AH-1G USA S/N 615246
GROSS WEIGHT 9530 LBS
C.G. STATION 193.6 IN.
DENSITY ALTITUDE 60 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
TAIL ROTOR PITCH - PERCENT FROM FULL LEFT
TRUE AIRSPEED - KNOTS (GROUND SPEED + WIND)

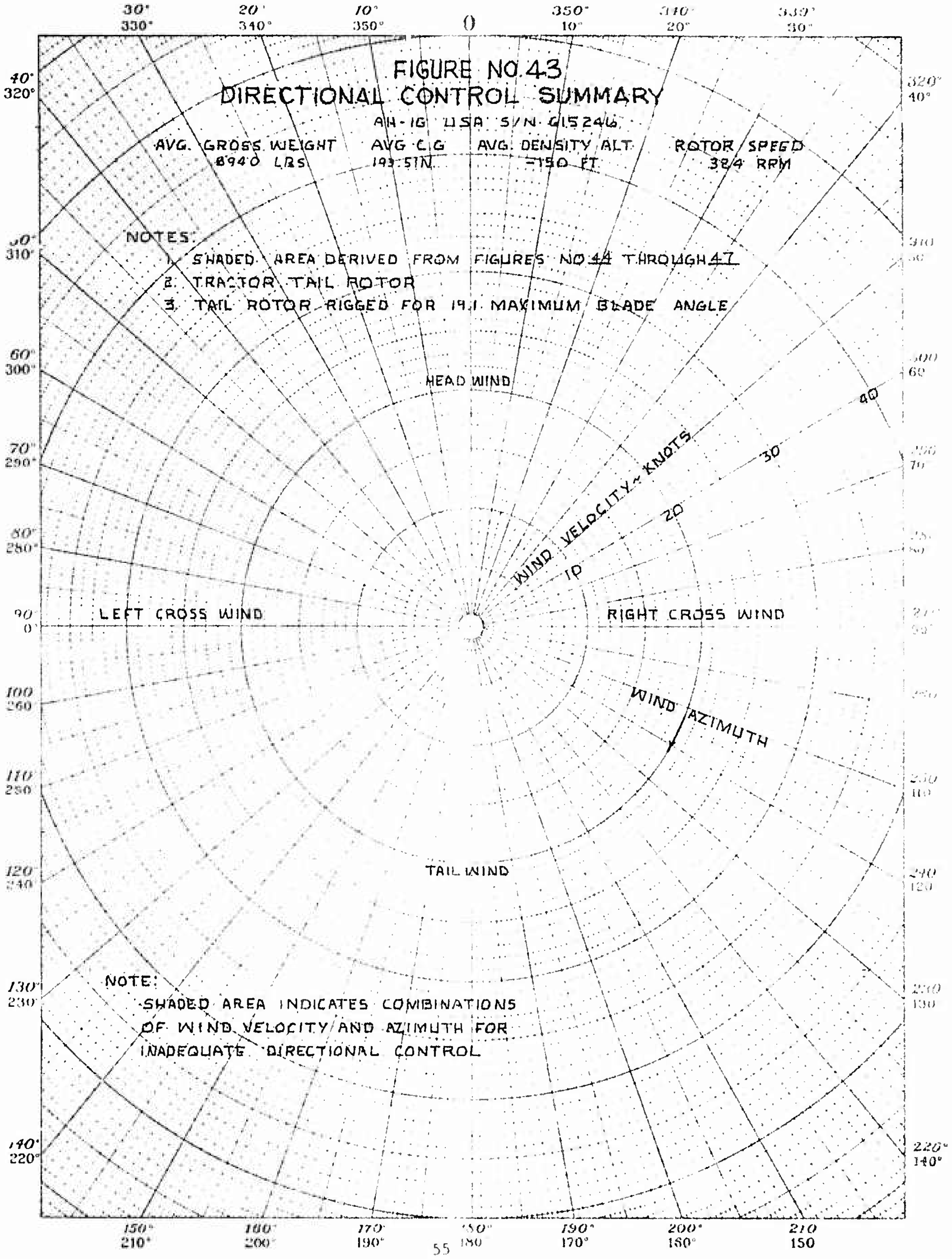


FIGURE NO. 43
DIRECTIONAL CONTROL SUMMARY
AH-1G USA S/N 615246
AVG. GROSS WEIGHT 8940 LBS
AVG C.G 193.5 IN.
AVG. DENSITY ALT. 150 FT.
ROTOR SPEED 324 RPM
NOTES:
1. SHADED AREA DERIVED FROM FIGURES NO 44 THROUGH 47
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1 MAXIMUM BLADE ANGLE
HEAD WIND
WIND VELOCITY ~ KNOTS
10
20
30
40
LEFT CROSS WIND
RIGHT CROSS WIND
WIND AZIMUTH
TAIL WIND
NOTE:
SHADED AREA INDICATES COMBINATIONS OF WIND VELOCITY AND AZIMUTH FOR INADEQUATE DIRECTIONAL CONTROL

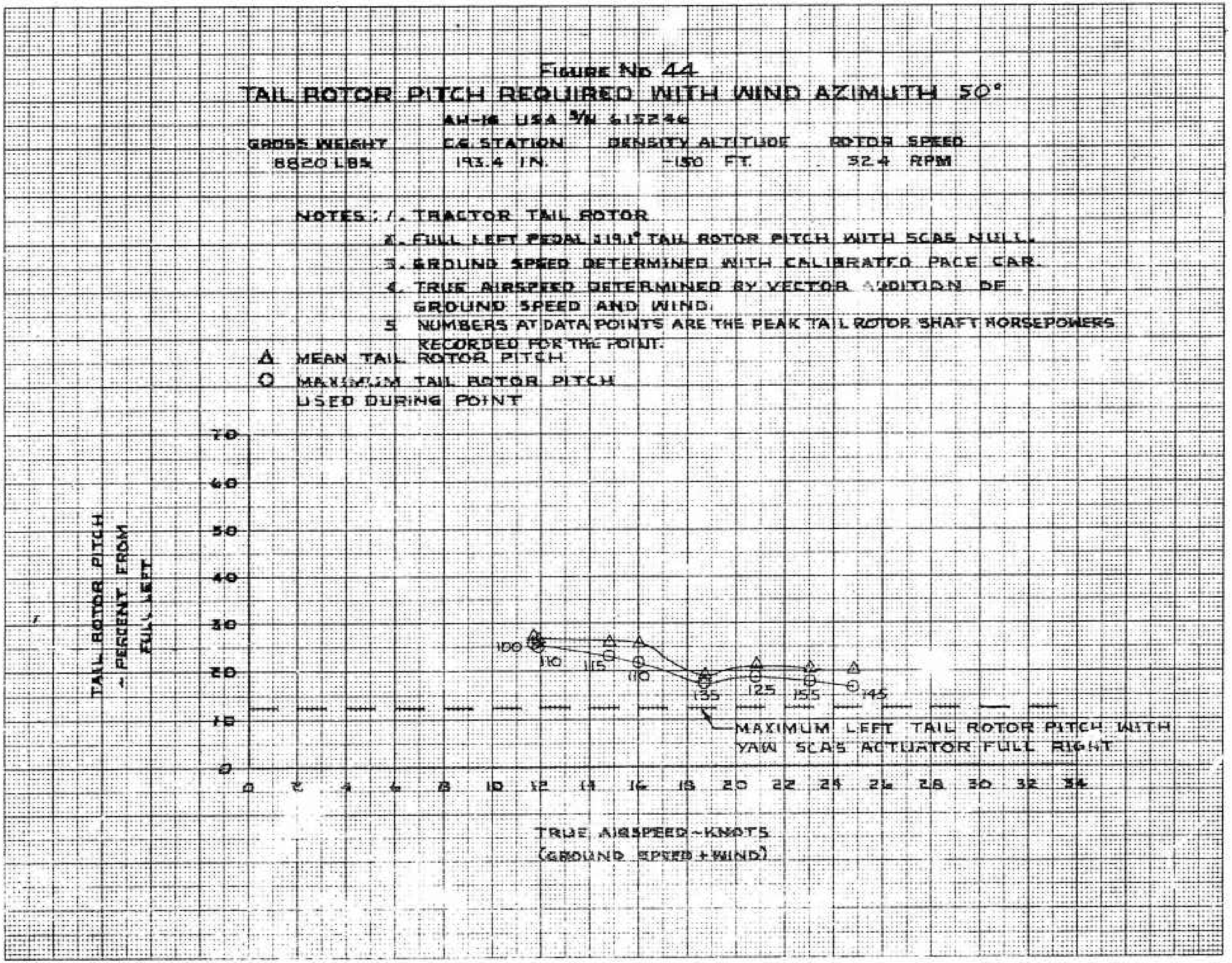


FIGURE No 44
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 50°
AH-1G USA S/N 615246
GROSS WEIGHT
8820 LBS
C.G. STATION
193.4 IN.
DENSITY ALTITUDE
-150 FT.
ROTOR SPEED
324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5 NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
Δ MEAN TAIL ROTOR PITCH
O MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
0
10
20
30
40
50
60
70
100
110
115
110
135
125
155
145
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
TRUE AIRSPEED ~ KNOTS
(GROUND SPEED + WIND)

Figure No 45

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°

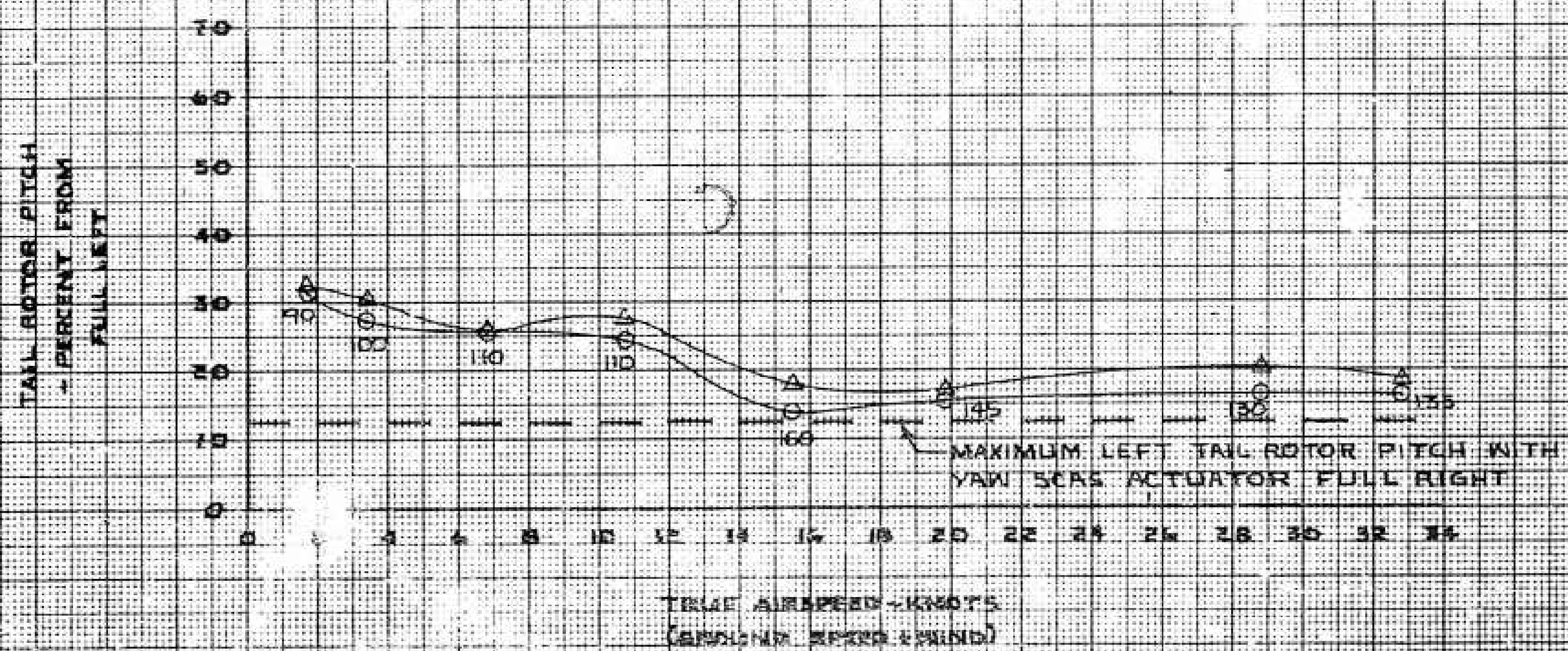
AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8980 LBS	193.6 IN.	-150 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT



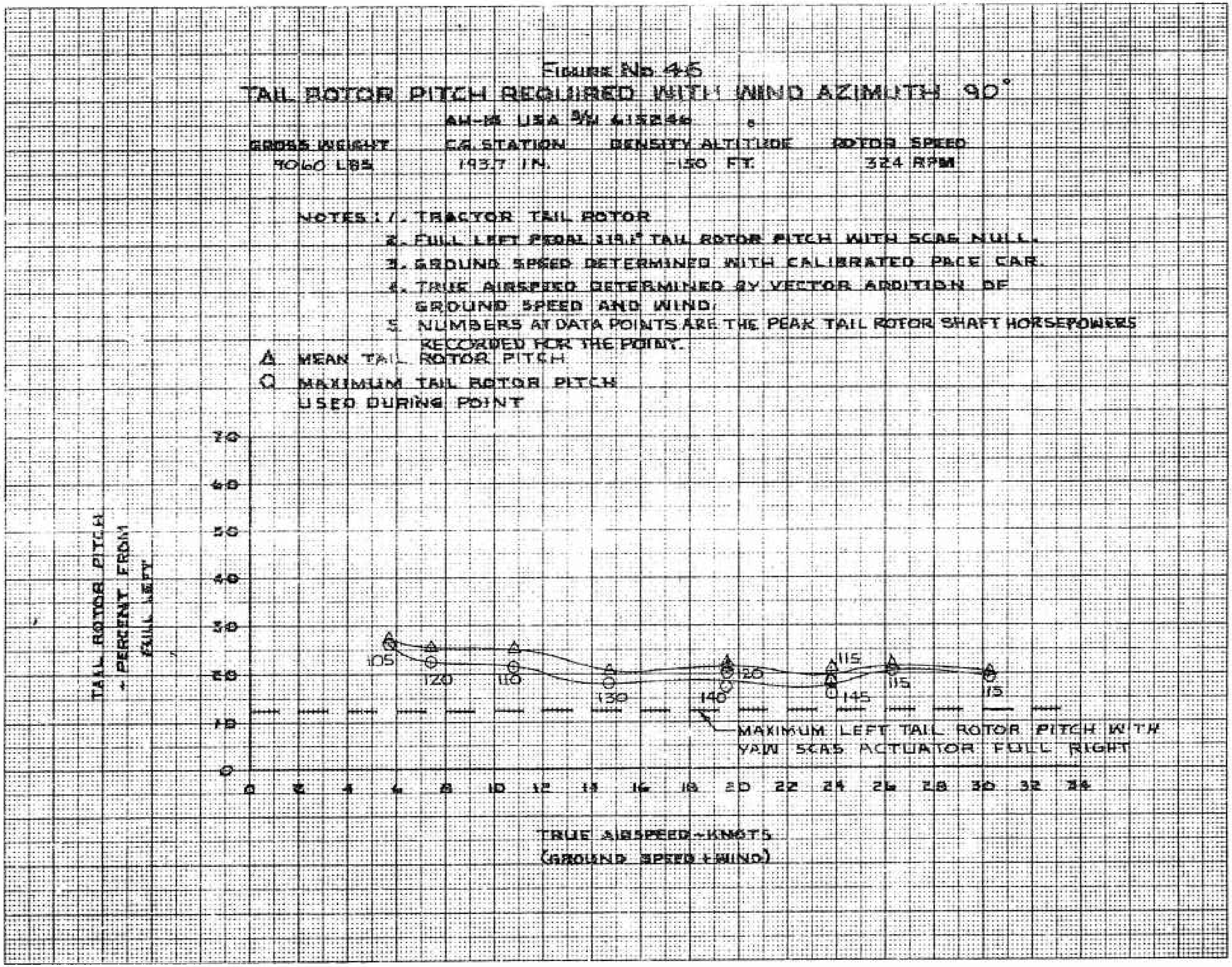


FIGURE No. 45
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°
AH-1G USA S/N 615246
GROSS WEIGHT 9060 LBS
C.G. STATION 193.7 IN.
DENSITY ALTITUDE -150 FT.
ROTOR SPEED 324 RPM
NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.
△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
70
60
50
40
30
20
10
0
105
120
110
130
140
120
115
145
115
115
MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
TRUE AIRSPEED ~ KNOTS
(GROUND SPEED + WIND)

FIGURE No. 47
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 110°
AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8900 LBS	193.5 IN.	-150 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

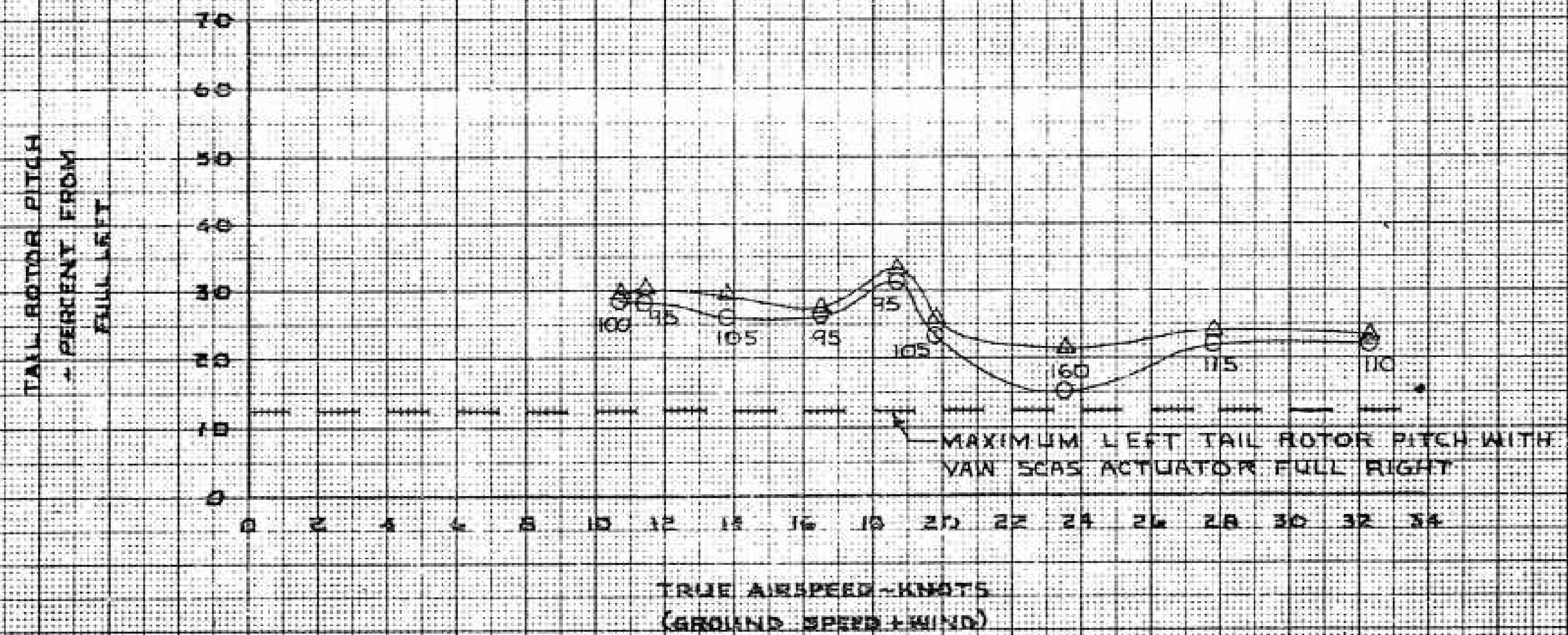


Figure No. 48

HOVERING TURN IN WIND

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9130 LBS.	192.5 IN	8760 FT.	324 RPM

NOTES:

1. WIND GUSTING FROM ZERO TO APPROXIMATELY 8 KNOTS
2. TRACTOR TAIL ROTOR
3. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

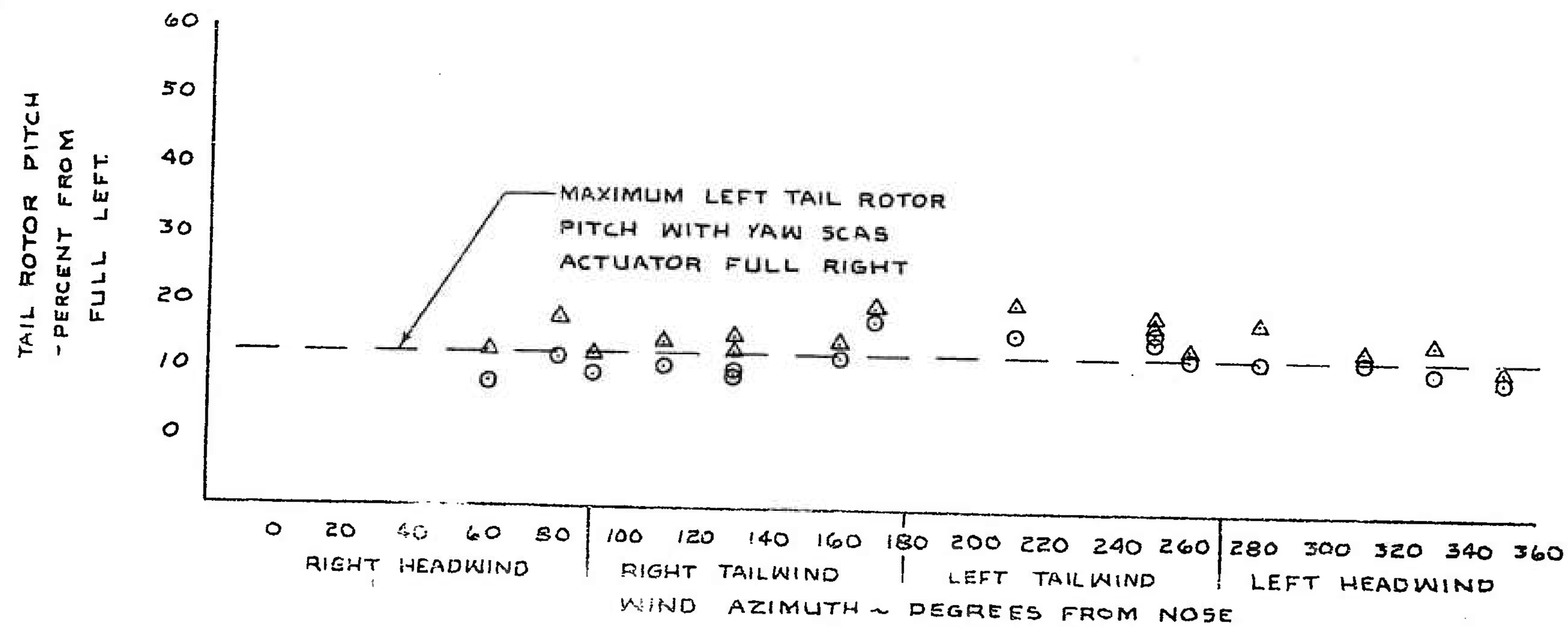


FIGURE NO. 49

TAIL ROTOR SHAFT HORSEPOWER TO ARREST RIGHT HOVERING TURN

AH-1G USA S/N 615246

SYM	GROSS WEIGHT ~ LBS.	C.G. STATION ~ IN.	DENSITY ALTITUDE ~ FT.	ROTOR SPEED ~ RPM
■	9100	192.5	8750	324
○	8100	192.7	7920	324

NOTES:

1. WIND LESS THAN APPROXIMATELY 8 KNOTS.
2. PEDAL INPUT COMPLETED IN LESS THAN APPROXIMATELY 1.5 SECONDS.
3. TRACTOR TAIL ROTOR
4. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL.

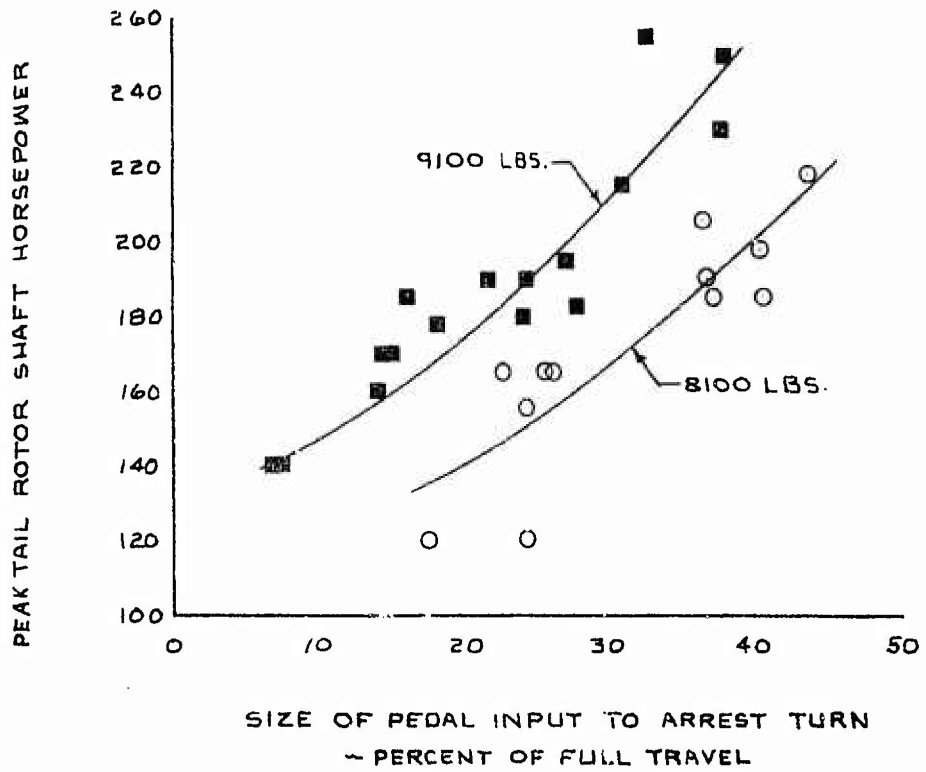


Table 2. Peak Tail Rotor Shaft Horsepower During Paced Flight
AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
8030 lbs 7330 ft 324 rpm

AZIMUTH ~ DEGREES (RELATIVE WIND)	AIRSPEED ~ KNOTS / PEAK TAIL ROTOR SHAFT HORSEPOWER									
20	AIRSPEED ~ KNOTS	3.9	7.2	11.0	15.6	20.8	25.8	29.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	90	90	85	85	85	75	65		
40	AIRSPEED ~ KNOTS	3.9	7.2	11.0	12.9	15.6	20.8	25.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	100	95	95	95	100	115	110		
70	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	95	110	115	140	175	125		
90	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8	
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	95	110	105	155	165	125	135	
120	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	115	110	95	140	115	95		
140	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	95	115	110	115	105	120	85		
160	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	95	125	120	125	140	80	60		
180	AIRSPEED ~ KNOTS	3.9	7.2	8.5	11	12.9	15.6	20.8	20.8	25.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	120	125	130	135	70	85	65	80
200	AIRSPEED ~ KNOTS	3.9	7.2	11	15.6	20.8	25.8			
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	115	115	55	45	60			
215	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	17.6	25.8			
	PEAK TAIL ROTOR SHAFT HORSEPOWER	100	105	120	135	45	20			
320	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8	
	PEAK TAIL ROTOR SHAFT HORSEPOWER	90	90	95	80	75	30	40	30	

Table 3. Peak Tail Rotor Shaft Horsepower During Paced Flight AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
8020 lbs 7790 ft 314 rpm

AIRSPEED ~ KNOTS
PEAK TAIL ROTOR SHAFT HORSEPOWER

AZIMUTH ~ DEGREES RELATIVE WIND								
30	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	82	78	82	82	93	73	102	82
70	3.9	7.2	7.2	11	12.9	15.6		
	92	107	97	116	102	126		
90	3.9	7.2	11	12.9	15.6	17.8		
	97	121	131	131	140	150		
120	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	97	111	78	92	116	107	97	111
150	3.9	7.2	11	12.9	15.6	21.5	25.8	30.5
	111	111	131	116	107	87	68	78
180	3.9	7.2	11	12.9	15.6	20.8	25.8	
	107	116	140	160	92	97	87	
210	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	97	87	102	102	126	44	39	39
240	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	102	121	155	58	34	24	15	15
270	3.9	7.2	11	12.9	15.6	20.8	25.8	
	87	97	116	140	87	73	19	
315	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	92	82	87	82	68	73	34	39

Table 4. Peak Tail Rotor Shaft Horsepower During Paced Flight AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
8680 lbs • 7190 ft • 324 rpm

AZIMUTH ~ DEGREES (RELATIVE WIND)									
35	AIRSPEED ~ KNOTS	3.6	8.7	10.2	12	14.6	19	24	28
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	95	105	110	120	120	110	110
65	AIRSPEED ~ KNOTS	3.4	7.2	11	12.9	15.6	19.1	19.8	
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	115	115	120	140	125	165	
90	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	19.1		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	110	120	95	170	155		
110	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	19.4		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	130	115	160	150	145	150		
140	AIRSPEED ~ KNOTS	5.5	10.6	13	15.8	18.5	22.5	29	32
	PEAK TAIL ROTOR SHAFT HORSEPOWER	115	110	145	110	110	145	120	105
160	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	100	100	120	90	95	80	80
180	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	135	150	130	80	85	75	55
200	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	90	145	125	130	55	40	40	30
280	AIRSPEED ~ KNOTS	4.5	7.6	11.6	13.2	17	21	26.4	31
	PEAK TAIL ROTOR SHAFT HORSEPOWER	95	105	110	125	145	65	25	20

Table 5. Peak Tail Rotor Shaft Horsepower During Paced Flight AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
9510 lbs • -120 ft • 324 rpm

AIRSPEED ~ KNOTS / PEAK TAIL ROTOR SHAFT HORSEPOWER

AZIMUTH ~ DEGREES: RELATIVE WIND										
70	5.7	7.4	10.8	14.7	19.5		23.8	28.3		
	95	110	120	125	165		165	135		
90	5.7	7.4	10.8	14.7	19.5	19.5	23.8	28.3		
	120	135	150	155	170	150	130	140		
110	5.7	7.4	10.8	14.7	19.5	19.5	23.8	28.3		
	110	115	150	165	140	115	110	120		
130	5.7	7.4	10.8	14.7	14.7	19.5	23.8	28.3	23.8	28.3
	120	110	115	120	100	125	105	95	85	105
160	5.7	7.4	10.8	14.7	19.5	23.8		28.3		
	95	100	155	115	110	95		75		
180	5.7	7.4	10.8	14.7	19.5	19.5	23.8	28.3		
	115	110	110	95	95	95	70	50		
200	5.7	7.4	10.8	14.7	19.5	19.5	23.8	28.3		
	95	120	95	70	60	40	40	40		
270	5.7	7.4	10.8	14.7	19.5	19.5	23.8	28.3		
	90	95	100	110	35	30	20	25		

Table 6. Peak Tail Rotor Shaft Horsepower During Paced Flight
AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
8940 lbs -150 ft 324 rpm

RELATIVE WIND AZIMUTH ~ DEGREES											
50	AIRSPEED ~ KNOTS	11.7	11.9	14.8	18.7	23	16	20.8	24.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	100	110	115	135	155	110	125	145		
70	AIRSPEED ~ KNOTS	1.7	3.4	6.8	10.7	15.5	19.8	28.8	32.8		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	90	100	110	110	160	145	130	135		
90	AIRSPEED ~ KNOTS	5.7	7.4	10.8	14.7	19.5	19.5	23.8		26.3	30.3
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	120	110	130	120	140	145		115	115
110	AIRSPEED ~ KNOTS	10.7	11.4	13.8	18.7	23.5	16.5	19.8	27.8	32.3	
	PEAK TAIL ROTOR SHAFT HORSEPOWER	100	95	105	95	160	95	105	115	110	

APPENDIX III TEST INSTRUMENTATION

1. Flight test instrumentation was installed in the test helicopter by the contractor prior to the start of this evaluation. Although other test instrumentation was installed in the test aircraft only those items on the oscillograph used in data collection for this test will be specified below. All instrumentation was calibrated by the contractor and witnessed or approved by the USAAVNTA flight test engineer. The flight test instrumentation was maintained by the contractor throughout the test program. The following parameters were utilized during this test:

Oscillograph:
- All flight control positions
- Tail rotor pitch (acme thread)
- Yaw attitude
- Tail rotor shaft torque
- SCAS actuator positions
- Engine torque
- Rotor speed

2. Additional items installed in the test aircraft specifically required for this test were:

Pilot's Panel:
- Altimeter
- Outside air temperature gage
- Directional control position indicator
- Calibrated directional gyro
- Calibrated compass
- Tail rotor torque gage
- VHF radio

APPENDIX IV

AH-1G OPERATING LIMITATIONS

1. Limit airspeed (V_L):

   Power on - 120 KIAS for all configurations and gross weights up to 9500 lbs at density altitude up to 3000 feet. For all configurations, reduce airspeed 8 KIAS per 1000 feet above 3000 feet.

   Power off - 120 KIAS.

2. Gross weight - Center of Gravity Envelope:

   Forward limit: Below 7000 lb, Fuselage Station (F.S.) 190. Linear decrease from F.S. 190 at 7000 lb to F.S. 192.1 at 95000 lb.

   Aft limit: Below 7650 lb, F.S. 201. Linear decrease from F.S. 201 at 7650 lb to F.S. 200 at 9500 lb.

3. Sideslip limits: 5 degrees at 190 KCAS. Linear increase to 20 degrees at 60 KCAS.

4. Maximum load factor:

5. Sideward and rearward flight: 35 kt

6. Maximum turn rate: 40 degrees per second

7. Maximum tail rotor horsepower, interim value proposed by contractor: 200 hp (inspection required)

8. RPM limits (steady state):

   Power on - 6600 to 6400 engine rpm
   324 to 314 rotor rpm

   Power off - 304 to 339 rotor rpm
   transient lower limit 250 rotor rpm

   Power on during dives and maneuvers 319 to 324 rpm

9. Temperature and pressure limits:

Engine oil temperature	93°C
Transmission oil temperature	110°C
Engine oil pressure	25 - 100 psi (lb per sq in.)
Transmission oil pressure	30 - 70 psi
Fuel pressure	5 - 20 psi

10. T53L-13 Engine limits - installed:

Normal rated power (maximum continuous)	625°C Exhaust gas temperature (EGT)
Military rated power (30-minute limit)	645°C EGT
Starting and acceleration (5-second limit)	675°C EGT
Maximum for starting and acceleration	760°C EGT
Torque pressure	50 psi

APPENDIX V DISTRIBUTION LIST

Agency	Test Plans	Equipment Failure Reports	Interim Reports	Final Reports
Commanding General US Army Aviation Materiel Command				
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USMC LnO	1	-	1	1
Aberdeen Proving Ground, Md 21005				

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13. ABSTRACT

A feasibility test of the tractor tail rotor modification of the AH-1G helicopter was conducted near Fort Worth, Texas (550-feet elevation), and Alamosa, Colorado (7535-feet elevation), during the period 7 October to 19 October 1967. This test was conducted to obtain quantitative flight test data to serve as a basis for determining if the tractor tail rotor modification proposed by the contractor for the AH-1G helicopter would correct the directional control problems which currently exist on the AH-1G helicopter with the standard tail rotor configuration. This test revealed that in-ground-effect (IGE) low speed directional control and IGE low speed dynamic directional stability were greatly improved by installation of the tractor tail rotor. IGE directional control limitations with the standard tail rotor installed were encountered at approximately 8100 pounds gross weight near sea level in previous tests. This test with the tractor tail rotor did not reveal any IGE directional control limitations at approximately 8940 pounds gross weight and near sea level. The test results indicate that additional directional control could be obtained with the tractor tail rotor, if the geometry of the directional control system were changed to negate the adverse effects of the stability and control augmentation system (SCAS) on the ability to obtain full left tail rotor pitch. The highest tail rotor horsepower encountered with large left pedal inputs to arrest hovering turns was 250 shaft horsepower. These tests proved that directional control deteriorated with increased gross weight, increased density altitude or decreased rotor speed. The test aircraft exhibited SCAS coupled pylon motion which has been a continuing problem on the AH-1G helicopter.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
AH-1G helicopter Tractor tail rotor modification In-ground-effect Low speed directional control 8100 pounds gross weight 8940 pounds gross weight Control augmentation system 250 shaft horsepower						

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